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DEPARTMENT OF FISH AND GAME

FEDERAL AID IN FISH RESTORATION
1999 Job Performance Report
Program F-71-R-24

REGIONAL FISHERIES MANAGEMENT INVESTIGATION
PANHANDLE REGION (Subprojects I-A, II-A, III-A, IV-A)

PROJECT I.	**SURVEYS AND INVENTORIES**
Job a.	**Panhandle Region Mountain Lakes Investigations**
Job b.	**Panhandle Region Lowland Lakes Investigations**
Job c.	**Panhandle Region Rivers and Streams Investigations**
PROJECT II.	**TECHNICAL GUIDANCE**
PROJECT III.	**HABITAT MANAGEMENT**
PROJECT IV.	**LAKE RESTORATION**

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1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: I-Surveys and Inventories

Subproject: I-A Panhandle Region

Job No.: a

Title: Mountain Lakes Investigations

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ABSTRACT

The Idaho Department of Fish and Game (IDFG) stocks around 49 mountain lakes in the Panhandle Region to provide diverse fishing opportunities. In recent years we have identified the need for an improved record of the number and size of all mountain lakes in the region, and for productivity-based stocking guidelines to optimize density and growth rates. Our objectives were to: 1) identify the total number of stocked and unstocked mountain lakes in the Panhandle Region; 2) refine existing surface area estimates of mountain lakes in the stocking program; and 3) develop a model to optimize fish growth and abundance by adjusting stocking rates based on lake productivity and size. We used 1:24,000 (7.5 minute) USGS topographical maps and a digital planimeter to enumerate all lakes with a surface area of at least 0.5 ha and above 1,000 m. We counted 124 lakes in the Panhandle Region with a surface area of at least 0.5 ha and an elevation of at least 1,000 m. Of these, 49 are currently being stocked on a regular basis by IDFG and 75 are not stocked, or have not been stocked for many years. We then corrected the existing surface area estimates listed in the stocking records. There was no consistent trend to under or overestimate area; however, comparisons indicated that the existing area estimates of many lakes were inaccurate. The inaccurate area records have obviously translated into erroneous estimates of stocking density. We surveyed 14 lakes in 1999 and used available data from two lakes surveyed in past years. We assessed several variables related to fish growth, and then developed a multiple regression model using elevation and stocking rate as independent variables and cutthroat trout age-at-length as a dependent variable. We found the model was useful in predicting growth, with a multiple r-value of 0.78, an r^2 value of 0.62 and an adjusted r^2 value of 0.54. We then used the regression model to plot curves depicting the relationships between stocking rates, elevation, and age-at-length. We developed stocking guidelines based on elevation and surface area that will optimize both growth and densities of cutthroat trout in Panhandle Region mountain lakes.

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INTRODUCTION

The Idaho Department of Fish and Game (IDFG) stocks around 49 mountain lakes in the Panhandle Region to provide diverse fishing opportunities. Species stocked include westslope cutthroat trout *Oncorhynchus clarki*, domestic Kamloops rainbow trout *O. mykiss*, golden trout *O. aguabonita* and grayling *Thymallus arcticus*. The number of lakes stocked has declined over the years as lakes prone to winterkill or lakes with reproducing brook trout populations have been deleted from the stocking list. Although we have accurate records of regional lakes stocked in recent decades (see Appendix A), we have not had an accurate estimate of the percentage of lakes stocked because the total number of "mountain lakes" in the region had not been documented. The term "mountain lake" lacks clear definition; however, in the Panhandle Region they can generally be described as lakes over 1,000 m in elevation and at least 0.5 ha in size. A primary objective of this effort was to quantify the total number of mountain lakes in the region.

Most of the mountain lakes are stocked with rainbow and/or cutthroat trout fry at target densities of around 600 fish/ha. Stocking rates in the Panhandle Region are generally on the upper end of the range used by other regions or found in literature (Der Hovanisian 1997). In many cases, stocking densities have been much higher or lower than the target of 600 fish/ha, a result of the absence of accurate acreage information on many lakes. A key element in evaluating stocking rates is to refine acreage estimates on all of the stocked mountain lakes. Most lakes have been stocked on alternate years, and no attempt to adjust stocking to accommodate the productivity of individual lakes has been made, although highly accessible, heavily fished lakes have been stocked each year. Four of the mountain lakes are accessible by road and are therefore stocked with catchable rainbow trout. Grayling and golden trout have been stocked at higher densities (500-1,500 fry/ha) because of the suspected higher mortality and the uncertainty of obtaining these species on a regular basis.

Stocking rates have generally been sufficient to provide high yield fisheries, and there have been few complaints about catch rates in mountain lake fisheries. Past surveys have demonstrated that most Panhandle Region mountain lakes provide high catch rates of fish around 250 mm total length (TL), but very few fish over 350 mm (TL). Past surveys have also indicated that most lakes have an abundance of old fish in the population. This suggests the lack of larger fish is more of a function of slow growth than the result of high exploitation. Physical, chemical, and biotic variables have been related to trout growth in California, Colorado, Wyoming, and Washington and are outlined in Der Hovanisian (1997). Stocking recommendations have been developed in Colorado (Nelson 1988) and Alberta (Donald and Anderson 1982) to maximize growth and catch rates based largely on elevation, total dissolved solids (TDS), and stocking density. In Idaho no statewide guidelines have been developed for stocking density and frequency, although Bahls (1990) identified variables associated with growth and condition in the Clearwater Region.

Because of the lack of stocking guidelines for the Panhandle Region and the likelihood that programs developed in other states or regions within Idaho are area-specific, we've identified a need for a more methodical, systematic, and efficient mountain lake stocking program. Based on stocking programs developed elsewhere, we believe that developing a model to modify stocking rates by adjusting for productivity can increase growth rates and improve efficiency of the mountain lake stocking program.

OBJECTIVES

1. Identify the total number of stocked and unstocked mountain lakes (minimum of 1,000 m in elevation and 0.5 ha in size) in the Panhandle Region.

2. Refine existing surface area estimates of mountain lakes in the stocking program.

3. Develop a model to optimize fish growth and abundance by adjusting stocking rates based on lake productivity and size.

METHODS

Enumeration of Panhandle Region Mountain Lakes

We searched each 1:24,000 (7.5 minute) USGS topographical map of the Panhandle Region for water bodies above 1,000 m in elevation. We used a Tamaya Planix 5000 Area-Line digital planimeter to estimate surface area. We then categorized all lakes with a surface area of at least 0.5 ha by major and minor drainage and recorded UTM latitude and longitude of each lake. We assigned numbers to unnamed lakes.

Area Estimation

We used the planimeter and topographical maps to re-estimate surface area of all lakes in the stocking program. We then corrected the existing surface area estimates and adjusted stocking densities accordingly.

Stocking Model Development

We surveyed 14 lakes in 1999 and used available data from two lakes surveyed in past years. Our intent was to survey lakes in which trout growth was least likely to be confounded by extraneous variables. We therefore identified all lakes in the Panhandle Region with the following criteria: 1) lakes without a reproducing population of brook trout, 2) lakes stocked with fry only (no catchables), 3) lakes stocked primarily with cutthroat trout. Mountain lake assessment surveys entail sampling and/or documenting presence of fish and other aquatic biota, limnological sampling, and a recreational use survey. We collected fish samples with floating and sinking experimental gill nets and conventional angling methods. We recorded species, length and weight of all fish netted, and we collected otoliths for age analysis. We categorically assessed the quality and quantity of spawning habitat in the inlets and outlets of lakes, and we recorded any observed spawning activity. Physical characteristics surveyed included the type of lake, aspect, depth profile and inlet/outlet documentation. Chemical characteristics surveyed were alkalinity, TDS, conductivity, transparency, pH, and temperature. The recreational use survey included the quality and level of use of access and camping facilities, and a creel survey of anglers present (including our own angling efforts) to assess catch rates, species composition, and size of angled fish. We also recorded information pertaining to the presence of amphibians and aquatic invertebrates.

The stocking model is based on the relationship between growth rates and measurable factors potentially affecting growth rates. Independent variables identified for potential use in the model were conductivity, TDS, elevation, current stocking density, and accessibility (as an index of fishing pressure). Because some lakes were stocked annually, whereas others were stocked only on alternate years, we converted all lakes to annual stocking density (i.e., if a lake was stocked on alternate years with a density of 600 fry/ha, annual density was entered as 300 fry/ha). Previous estimates of surface area were inaccurate for several lakes resulting in erroneous density estimates; therefore, we recalculated densities using the improved surface area estimates. The dependent variable used was age-at-length. We used otolith analysis to estimate fish length-at-age and then converted the relationship to estimate the age at which fish in the lake could be expected to achieve a length of 250 mm. In many of the lakes, we were able to validate the otolith age estimates by stocking records.

RESULTS

Enumeration of Panhandle Region Mountain Lakes

We counted 124 lakes in the Panhandle Region with a surface area of at least 0.5 ha and an elevation of at least 1,000 m (Appendix B). Of these, 49 are currently being stocked on a regular basis by IDFG and 75 are not stocked or have not been stocked for many years. Antelope and Sand lakes are also regularly stocked lakes listed in the mountain lake stocking records; however, these two lakes are below 1,000 m in elevation and therefore were not included in this count. Of the remaining 75 unstocked mountain lakes, at least 20 are known to have reproducing populations of brook trout.

Area Estimation

Surface area estimates of several lakes in the stocking program were corrected based on the planimeter estimates. There was no consistent trend to underestimate or overestimate area; however, comparison indicated that the existing area estimates of many lakes were inaccurate (Table 1). The new area estimates of 30 of the 49 regularly stocked lakes differed from the old estimates by at least 10%. Seventeen of 49 were off by a margin of at least 25%, and 4 were off by a margin of at least 100%. The inaccurate area records have obviously translated into erroneous estimates of stocking density.

Table 1. Historically used surface area estimates and resulting stocking densities for mountain lakes in the Panhandle Region, Idaho, compared with the modified surface area estimates and stocking densities obtained using a digital planimeter.

	Historical estimates		1999 estimates		
Lake	Area (ha)	Density	Area (ha)	Density	Stocking frequency
KOOTENAI DRAINAGE					
Hidden	20.2	618	18.2	687	Annual
Lake Mountain (Cuttoff)	2.8	618	2.0	865	Alternate
West Fork	4.9	618	4.5	675	Annual
Long Mountain	1.2	1,236	0.8	1,854	Annual
Parker	1.2	1,236	1.6	803	Annual
Long Canyon (Smith)	2.4	1,236	2.0	1,483	Annual
Big Fisher	4.0	618	3.6	692	Alternate
Myrtle	8.1	618	8.1	618	Alternate
Trout	2.8	618	2.8	618	Alternate
Pyramid	4.5	618	3.2	853	Annual
Ball	2.4	618	2.4	618	Alternate
Little Ball	1.6	618	0.8	1,236	Alternate
Snow	4.0	618	3.6	687	Alternate
Roman Nose 3	4.9	618	4.8	625	Annual
Queen	2.0	618	1.0	1,236	Alternate
Debt	2.0	618	2.0	618	Alternate
Spruce	2.0	618	2.0	618	Annual
Copper	2.0	618	0.6	2,059	Alternate
Callahan (Smith)	4.0	618	3.2	771	Alternate
PEND OREILLE DRAINAGE					
Hunt	4.9	618	5.7	531	Annual
Standard	6.5	618	5.3	761	Alternate
Two Mouth 2	2.0	618	1.6	774	Alternate
Two Mouth 3	8.1	618	3.2	1,545	Alternate
Mollies	0.8	618	0.8	618	Alternate
Fault (Hunt Pk 1)	2.4	618	2.4	618	Alternate
McCormick (Hunt Pk 2)	1.3	618	1.3	618	Alternate
Little Harrison	2.6	618	2.6	618	Alternate
Harrison	11.7	618	11.7	618	Annual
Beehive	2.8	618	2.4	722	Alternate
Dennick	3.2	618	3.2	618	Annual
Sand	2.0	618	2.0	618	Annual
Antelope	6.5	153	6.5	153	Annual
Caribou	2.8	618	2.8	618	Annual

Table 1. (cont.)

Lake	Historical estimates Area (ha)	Historical estimates Density	1999 estimates Area (ha)	1999 estimates Density	Stocking frequency
COEUR D'ALENE DRAINAGE					
Elsie	4.0	741	6.1	494	Annual
Lower Glidden	4.9	620	5.7	531	Annual
Crater	2.0	1,236	1.6	1,545	Annual
Dismal	NA	NA	2.4	109	Annual
Bacon	3.6	618	2.0	1,112	Alternate
Forage	1.2	124		158	Annual
Halo	4.9	618	4.0	741	Alternate
Crystal	4.0	618	4.0	618	Alternate
CLEARWATER DRAINAGE					
Devils Club	1.6	618	1.2	823	Alternate
Big Talk	NA	NA	2.0	1,236	Alternate
Larkins	4.9	618	3.2	927	Alternate
Mud	2.4	618	2.0	741	Alternate
Northbound	4.9	618	4.9	618	Alternate
Skyland	5.3	618	5.3	618	Alternate
Noseeum	1.6	618	1.6	618	Alternate
Steamboat	3.6	1,411	2.8	1,814	Annual

Stocking Model Development

We found a wide range of ages and growth rates in the surveyed lakes. Age of cutthroat trout at 250 mm ranged from 2.4 years in Sand Lake to 9.1 years on West Fork Lake (Table 2; descriptions and characteristics of the individually surveyed lakes are in Appendix C). The broad range of ages facilitated linear and multiple regression analysis with various independent variables. We first conducted three simple linear regression analyses using age-at-250 mm as the dependent variable and stocking rate, conductivity, and elevation as the dependent variables. The coefficient of determination (r^2) for stocking rate was 0.25, indicating that stocking density explained around 25% of the variability in age-at-250 (Figure 1). We found an r^2 of 0.54 for conductivity, indicating that around half of the variability in growth was related to conductivity (Figure 2). Similarly, the r^2 for elevation was 0.49, indicating that around half of the variability in growth was related to elevation (Figure 3). We were unable to find a significant relationship between the categorical variable of level of use and growth rate (r^2 value of 0.001). We did not attempt to use any measure of spawning activity in the model because of the difficulty in assessing successful reproduction. Although we found spawning fish in several lakes, we believe successful reproduction was minimal. Most lakes had a notable lack of suitable habitat in inlets. Also, we found cutthroat trout spawning in mid-August, which suggests fry emergence and growth to a size sufficient to survive winter was unlikely.

We used the three variables with meaningful correlation in a multiple regression analysis to develop a more accurate prediction of growth rates. We found that a multiple regression model using all three variables yielded a multiple r-value of 0.80, an r^2 value of 0.64 and an adjusted r^2 value of 0.52. These values indicate that growth rates predicted by the model are well correlated to the observed growth rates (Figure 4). The similar correlation coefficients between elevation and TDS indicated likely auto-correlation between these two variables. Therefore, we conducted a regression analysis between these two variables and found a nonlinear (exponential) relationship with an r^2 value of 0.80 (Figure 5). Because conductivity is not a readily available parameter without on-site measurement and is highly correlated with elevation, we opted to eliminate it as a variable in the model. The resulting multiple regression using only elevation and stocking rate as independent variables yielded a multiple r-value of 0.78, an r^2 value of 0.62 and an adjusted r^2 value of 0.54. In short, exclusion of the conductivity variable resulted in the loss of almost no predictive ability of the model (Figure 6), and increased the utility of the model because on site measurements are not necessary.

We used the regression model to plot curves depicting the relationships between stocking rates, elevation, and age-at-length (Figure 7). The figure illustrates the much greater potential of low elevation lakes to grow fish even at fairly high densities. For example, a lake at 1,200 m could produce 250-mm cutthroat trout in three years, even with an annual stocking density of 850 fish/ha. Conversely, lakes at elevations above 2,000 m will not likely produce 250-mm fish by age-3, even at very low stocking densities, and may only produce 250-mm fish by age-6 with densities of 20 fish/ha. Based on this model, adjusting stocking rates based on elevation as outlined in Table 3, will optimize both growth and densities. For simplicity and efficiency, we recommend stocking all lakes in the Kootenai and Pend Oreille river drainages on even years and stocking all lakes in the Spokane and Clearwater river drainages on odd years (Table 4).

Table 2. Length and growth characteristics of fish collected in 1999 from mountain lakes in the Panhandle Region, Idaho.

Lake	Size of fish collected		Age of fish collected	
	Mean	Maximum	Maximum	Age @ 250 mm
Copper	160	178	1	
Caribou	245	350	7	4.3
Harrison	199	280	7	6.7
Hero	295	343	7	3.3
Hidden	237	323	5	4.8
Larkins	267	400	9	5.0
Little Ball	200	248	7	8.0
Northbound	301	343	9	2.6
Noseeum	240	280	4	4.5
Pyramid	211	260	5	6.4
Roman Nose #3	228	250	5	4.8
Sand	307	438	4	2.4
Snow	204	230	4	NA
Spruce	311 (n = 1)	311	NA	NA
West Fork	241	254	7	9.1

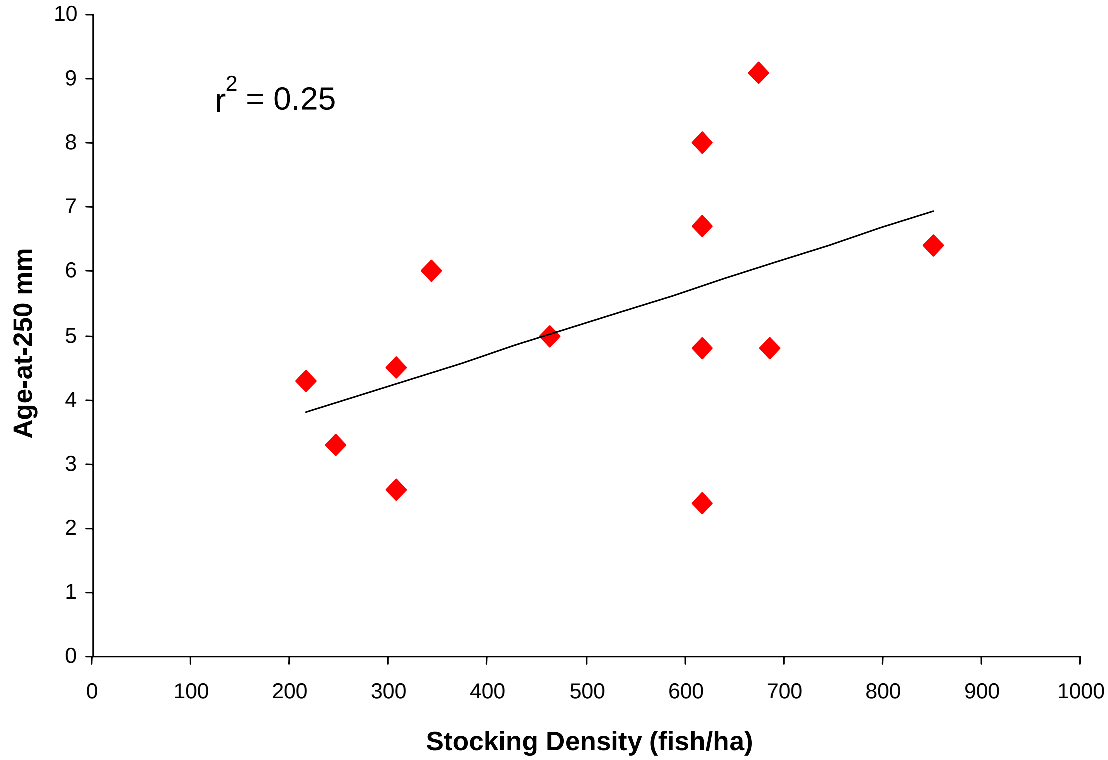

Figure 1. Relationship between stocking density (fish/ha) and cutthroat trout growth in mountain lakes of the Panhandle Region, Idaho.

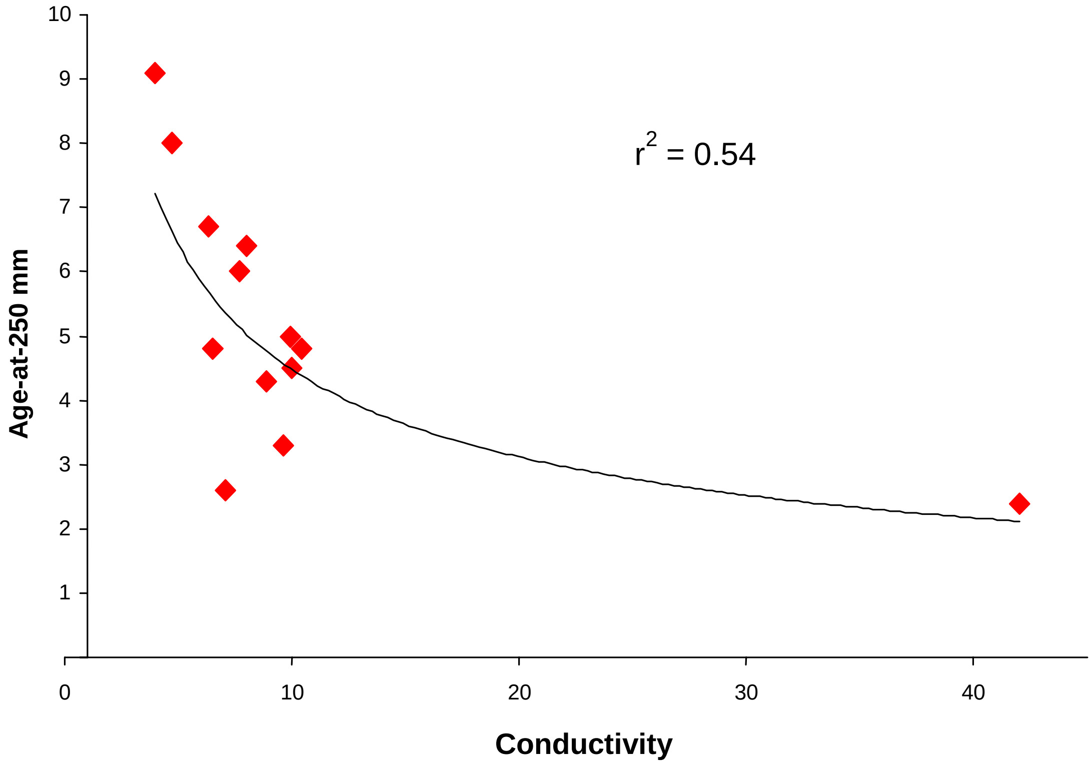

Figure 2. Relationship between conductivity (Φm/cm) and cutthroat trout growth in Panhandle Region, Idaho, mountain lakes. Line was fit using a non-linear power regression.

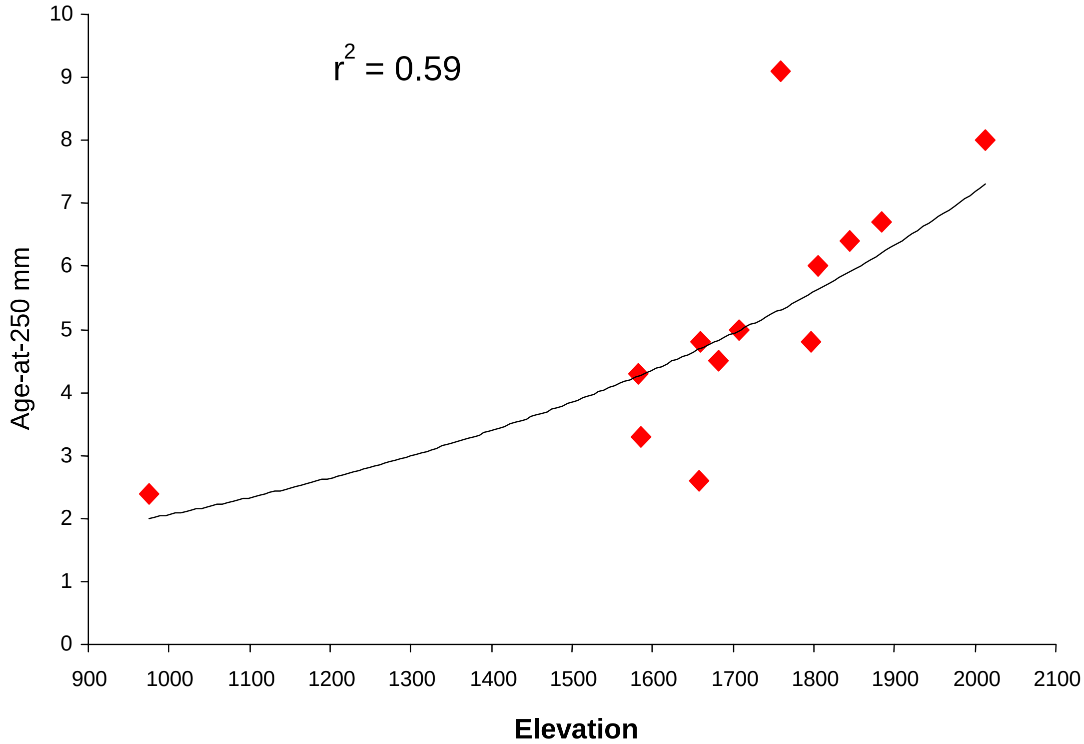

Figure 3. Relationship between elevation (m above msl) and cutthroat trout growth in Panhandle Region, Idaho mountain lakes. Line was fit using a non-linear exponential regression.

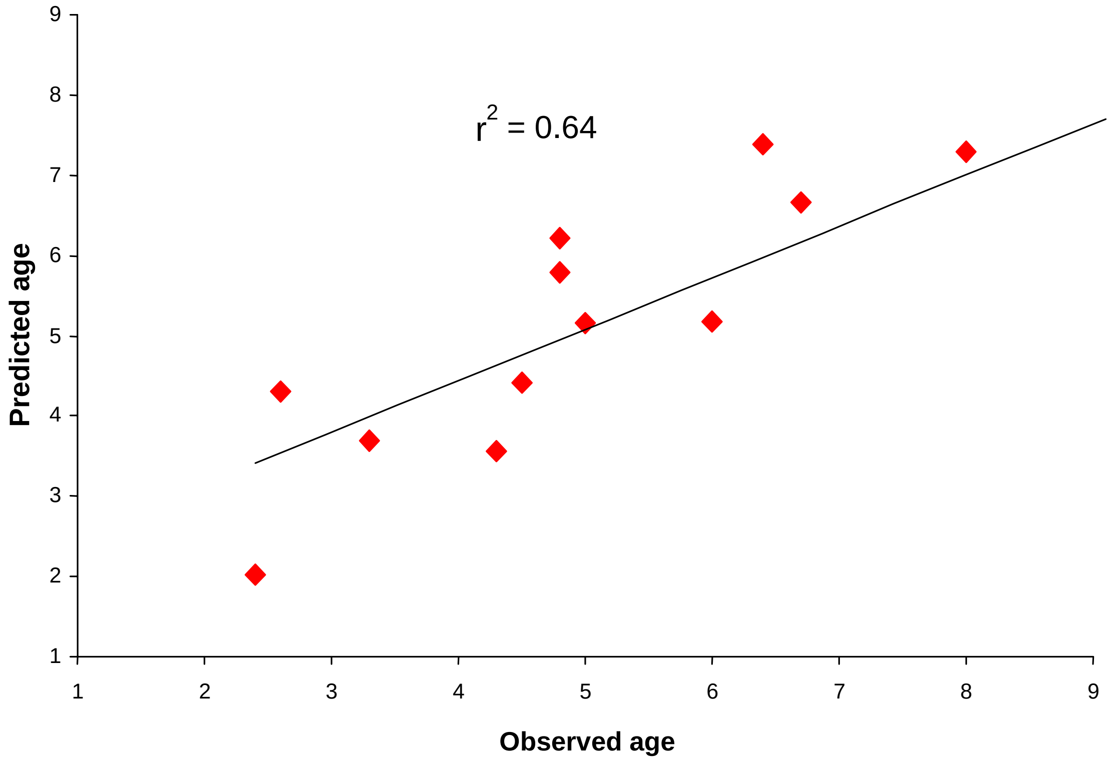

Figure 4. Linear regression model depicting observed cutthroat trout growth versus cutthroat trout growth predicted based on conductivity, elevation, and stocking densities in Idaho Panhandle Region mountain lakes.

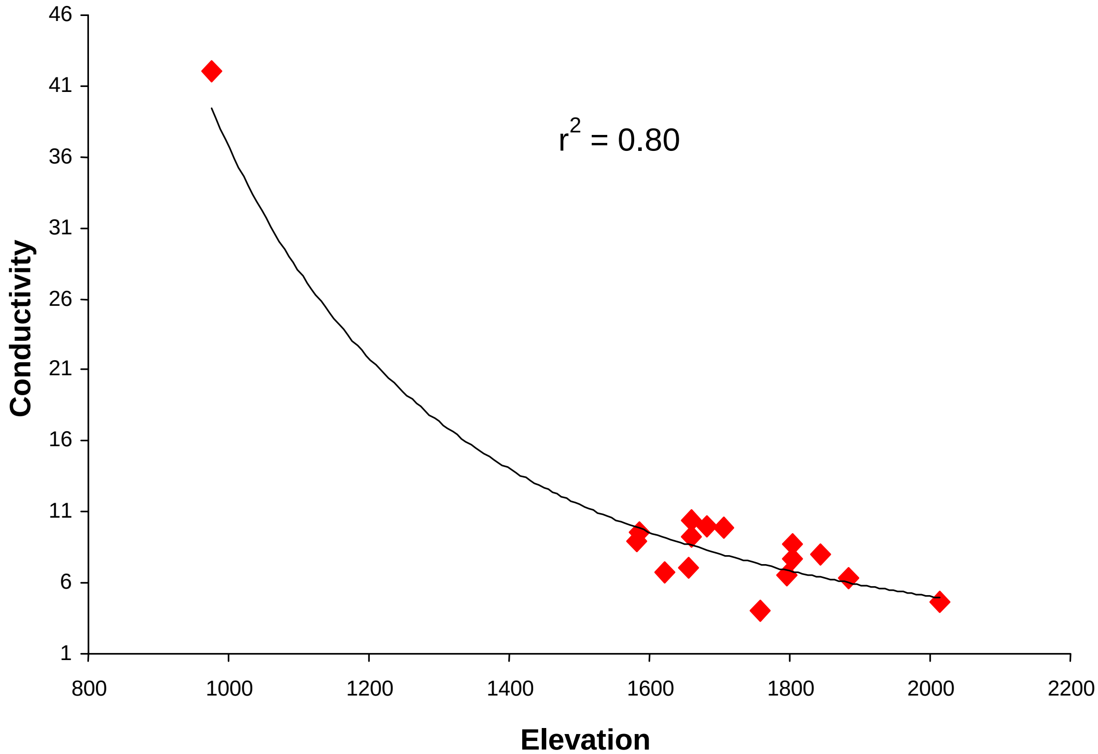

Figure 5. Linear regression model depicting conductivity as a function of elevation in mountain lakes of the Panhandle Region, Idaho.

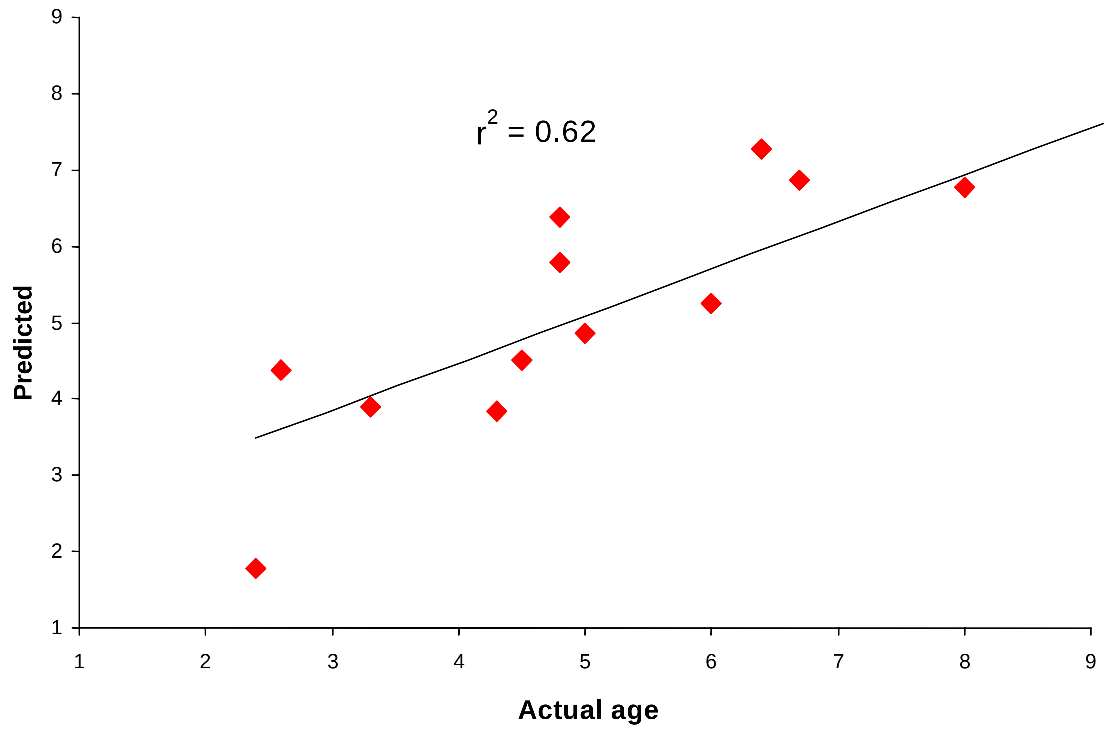

Figure 6. Linear regression model depicting observed cutthroat trout growth versus cutthroat trout growth predicted based solely on elevation and stocking densities in Idaho Panhandle Region mountain lakes.

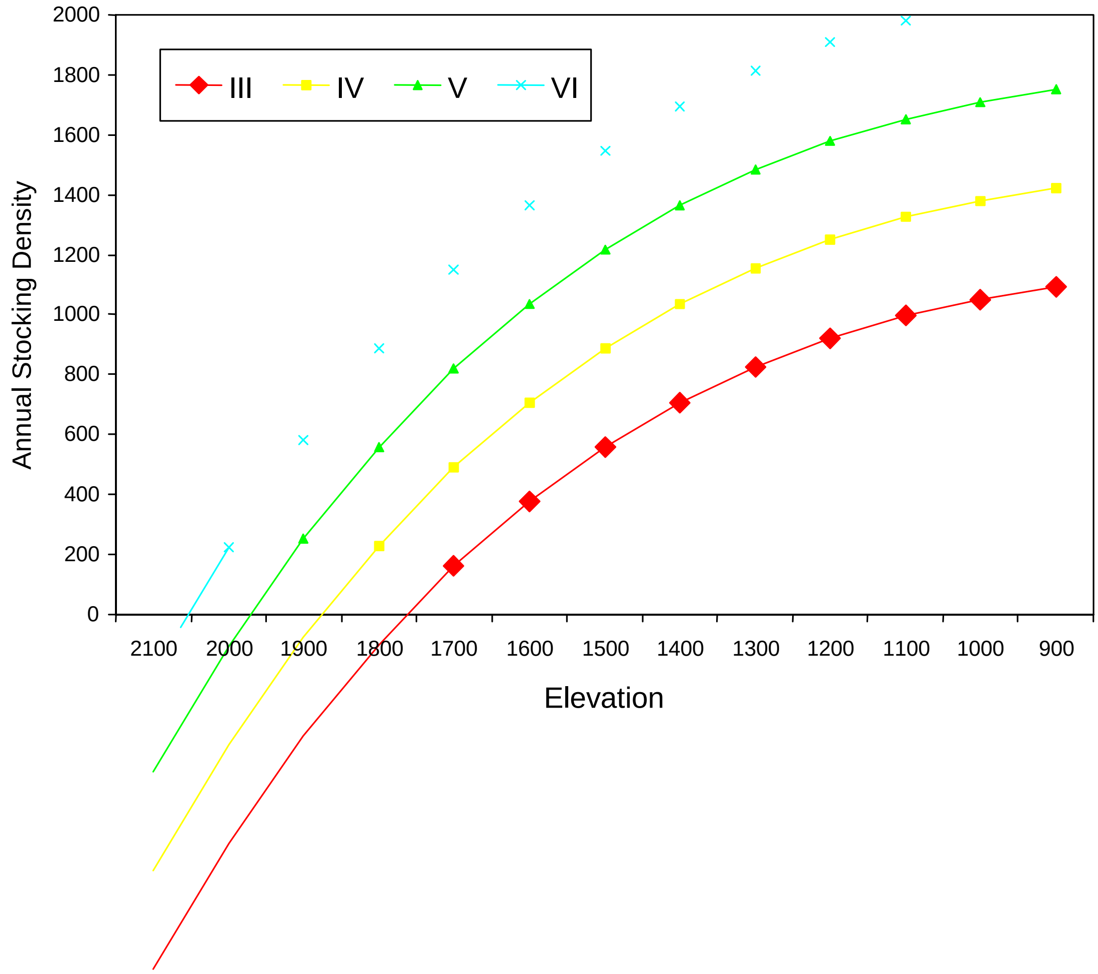

Figure 7. Regression model depicting the elevation-specific stocking densities necessary to achieve 250 mm in length for age-3, age-4, age-5 and age-6 cutthroat trout in Idaho Panhandle Region mountain lakes.

Table 3. Recommended stocking rates for cutthroat trout fry based on elevation and surface area in mountain lakes of the Panhandle Region, Idaho.

Elevation (m above msl)	Density (fry/ha on alternate years)
Over 1,830 m	500
1,525-1,830 m	750
1,000-1,525 m	1,000

Table 4. Stocking schedule for mountain lakes of the Panhandle Region, Idaho.

Lake	Code	Surface area (ha)	Number requested	Species	Substitute species	Stocking year
KOOTENAI DRAINAGE						
Hidden	01-103	18.0	13,500	KT	C2	Even
Lake Mtn (Cuttoff)	01-104	2.0	1,000	C2	KT	Even
West Fork	01-109	4.5	3,300	C2	KT	Even
Long Mountain	01-112	0.8	1,000	GR	None	Even
Parker	01-113	1.9	800	GN	GR	Even
Long Canyon	01-115	0.8	2,500	GN	GR	Even
Big Fisher	01-117	3.7	1,800	C2	KT	Even
Myrtle	01-122	8.1	6,000	C2	KT	Even
Trout	01-124	2.7	1,400	KT	C2	Even
Pyramid	01-125	3.2	1,600	KT	C2	Even
Ball	01-126	2.7	1,200	C2	KT	Even
Little Ball	01-127	0.8	1,000	GR	None	Even
Snow	01-134	3.6	2,700	C2	KT	Even
Roman Nose #3	01-137	4.8	3,600	KT	C2	Even
Queen	01-148	1.0	900	C2	KT	Even
Debt	01-157	0.5	900	C2	KT	Even
Spruce	01-154	2.6	1,500	KT	C2	Even
Copper	01-155	0.5	600	C2	KT	Even
Callahan	01-166	3.2	4,000	GR	None	Even
PEND OREILLE DRAINAGE						
Hunt	02-101	5.6	4,200	C2	KT	Even
Standard	02-103	2.4	3,900	C2	KT	Even
Two Mouth #2	02-107	1.5	1,200	C2	KT	Even
Two Mouth #3	02-108	1.6	1,600	C2	KT	Even
Mollies	02-114	0.8	600	C2	KT	Even
Fault (Hunt Pk #1)	02-121	2.3	1,500	C2	KT	Even
McCormick (Hunt Pk #2)	02-122	1.1	600	C2	KT	Even
Little Harrison	02-126	2.6	1,400	C2	KT	Even
Beehive	02-128	2.3	1,200	C2	KT	Even
Harrison	02-129	11.7	5,800	C2	KT	Even
Dennick	02-171	3.2	4,000	C2	KT	Even
Sand	02-172	2.0	2,500	C2	KT	Even
Caribou (Keokee Mtn)	02-196	2.8	2,100	C2	KT	Even

Table 4. Continued.

Lake	Code	Surface area (ha)	Number requested	Species	Substitute species	Stocking year
SPOKANE DRAINAGE						
Lower Glidden	03-123	5.7	2,800	GR	None	Odd
Gold	03-125	1.2	900	KT	None	Odd
Crater	03-133	1.5	2,000	GR	None	Odd
Dismal	03-138	2.6	1,200	GR	None	Odd
Bacon	03-144	3.6	2,700	C2	KT	Odd
Forage	03-146	2.9	2,100	GN	GR	Odd
Halo	03-147	4.0	2,000	C2	KT	Odd
Crystal	03-060	4.1	3,000	C2	KT	Odd
LITTLE NORTH FORK CLEARWATER DRAINAGE						
Devils Club	06-113	1.2	900	C2	KT	Odd
Big Talk	06-114	2.1	1,500	C2	KT	Odd
Larkins	06-117	3.3	2,400	C2	KT	Odd
Mud	06-118	1.9	1,500	KT	C2	Odd
Hero	06-119	2.0	1,500	C2	KT	Odd
Heart	06-122	13.4	6,600	KT	None	Odd
Northbound	06-123	4.7	3,600	C2	KT	Odd
Skyland	06-125	5.4	6,500	KT	None	Odd
Fawn	06-126	4.9	3,900	C2	KT	Odd
Noseeum	06-130	1.9	1,200	C2	KT	Odd
Steamboat	06-131	2.9	3,500	GR	None	Odd

Sum of number requested

	C2	K1	GR	GN	Total
Odd year	22,700	15,500	9,500	2,100	49,800
Even year	49,000	21,600	6,000	3,300	79,900
Total	71,700	37,100	15,500	5,400	129,700

DISCUSSION

Based on our map-based enumeration and summary, we are actively stocking only around 40% of the total number of mountain lakes in the region. Although the number of lakes with self-sustaining populations of fish (primarily brook trout) is not exact, the summary indicates that IDFG has left many lakes fishless. Recent years have seen an increase in concerns relating to the impact of introduced fish on native fauna--particularly fish, amphibians, and invertebrates (Horton and Ronayne 1995; Bahls 1990). The importance of leaving a portion of the state's mountain lakes fishless has been recognized and is specified as a guiding principle in the Five-Year Fisheries Management Plan (IDFG 1996). Der Hovanisian (1997) reported that only around a third of the 2,000 mountain lakes identified statewide have been stocked at some time during the past 50 years. We believe the mountain lake stocking program in the Panhandle Region is consistent with IDFG objectives for preserving healthy native fauna. In addition to the large percentage of lakes left fishless, we have greatly minimized the risk to downstream native fish populations by using fish native to the drainage. We are currently exploring the potential for sterile triploid rainbow trout to replace cutthroat trout when native fish are not available.

A large part of the "fine tuning" of the mountain lake stocking program has likely been accomplished by correcting erroneous surface area estimates. The disparity between previously recorded surface area estimates and those estimates using the digital planimeter has led to gross inconsistencies in stocking density. Whereas the goal for most mountain lakes has been to stock fry at densities of around 600 fish/ha (some on alternate years and some every year), several lakes were being stocked with densities greater than 1,000 fish/ha, and some even exceeded 2,000 fish/ha. Although stocking density was not the most important variable in the model, it still accounted for significant portion of the variability in fish growth. These results were not entirely consistent with Bahls (1990), who did not find stocking density to be an important predictor of fish growth or condition. The lack of a significant relationship in that study was attributed in part to inadequate information on stocking densities (Bahls 1990). Alternatively, the low densities and three-year rotation used in the Clearwater Region may not have represented a sufficiently wide range or high enough densities to depict the relationship. Although not by design, the erroneous stocking densities in the Panhandle were very useful in developing the stocking model because they provided a broad range of data points for the regression analysis.

The importance of elevation, conductivity, and stocking densities in relation to fish growth in this evaluation was most similar to results of studies in Colorado (Nelson 1988) and Alberta (Donald and Anderson 1982). Nelson (1988) concluded that stocking rates should be adjusted for elevation and angling pressure, and where possible, alkalinity. In general, he recommended a 28% decrease in stocking rate for each 305 m increase in elevation. Donald and Anderson (1982) found TDS and stocking density were the two most important variables in predicting trout growth. [Note: TDS, which explained 42% of the variability in size-at-age in their study, is very strongly related to conductivity, and one metric can be used to approximate the other (Rainwater and Thatcher 1960). Unlike Bahls (1990) and Nelson (1988), we found no predictive value in angling pressure. This may be the result of an inability to accurately quantify that parameter. For lack of a better metric, we used the level of accessibility to index angling use. This approach may have been flawed because some easily accessed lakes in the region receive very little fishing pressure, whereas other remote lakes receive moderate to heavy pressure. Our regression analysis indicated that, although all three parameters (stocking density, elevation, and conductivity) were related to cutthroat trout growth, the strong auto-correlation of elevation and conductivity eliminated the need for on-site lake evaluation. We recognize that the relationship between elevation and growth may not only be a function of conductivity, but of growing season and temperature. This further supports our conclusions that incorporating elevation can optimize stocking rates.

We believe these stocking guidelines will improve quality and efficiency of the mountain lake fish-stocking program. However, there are factors not addressed by the model that limit its utility. First, the guidelines are based on large-scale relationships and do not address lake-specific characteristics. Unique variations in productivity related to aspect, depth, geology, and natural reproduction, are not incorporated. Obviously, stocking rates can and should be modified to maximize the potential of individual lakes when on-site surveys suggest room for improvement. Secondly, this evaluation was based solely on cutthroat trout. Rainbow trout, golden trout, and grayling likely have distinct, species-specific growth and longevity characteristics. This study indicated that although cutthroat trout growth was not typically fast, longevity was as much as nine years. This was consistent with conclusions drawn by Nelson (1988) who looked at several species and found that rainbow trout have more rapid growth in mountain lakes than cutthroat trout but 2-4 years less longevity. Brook trout were typically the slowest growing species, but they had a wide range of longevity. We have little information available on growth rates and longevity of golden trout and grayling. Based on the high densities and small sizes of these species observed and reported in previous years, we suspect a reduction in stocking rates is appropriate for these species as well. They have been stocked with as many as 1,500 fry/ha annually, when available. A decrease to 1,000 fry/ha on alternate years (or 500 fry/ha annually) would likely improve growth rates and provide a higher quality fishery. An evaluation of regional lakes stocked with grayling and golden trout in the near future would be valuable in assessing stocking rates for these species. Finally, if sterile rainbow trout will be used on a broad scale to replace fertile rainbow and cutthroat trout in regional mountain lakes, a similar analysis that utilizes their unique growth rates and longevity should eventually be completed.

RECOMMENDATIONS

1. Stock all lakes on an alternate year schedule.
2. Stock lakes in the Kootenai and Pend Oreille drainages on even years and lakes in the
3. Spokane and Little North Fork Clearwater drainages on odd years.
4. Stock only westslope cutthroat and sterile rainbow trout fry.
5. Stock decreasing densities of fry with increasing lake elevation (see Table 3).
6. Stock grayling and golden trout at 1,000/ha on alternate years.
7. Conduct species specific stocking analyses for sterile rainbow trout and grayling.

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APPENDICES

Appendix A. Number and species of fish (fry except where noted) stocked into mountain lakes in Panhandle Region from 1992-1999.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
KOOTENAI DRAINAGE						
Hidden Lake (01-103)	18.0	1999	12,500	694	Westslope CT	
		1998	12,500	694	Kamloops RBT	
		1997	12,500	694	Westslope CT	
		1996	5,338	297	Kamloops RBT	
		1995	12,500	694	Westslope CT	
		1994	12,500	694	Hayspur RBT	
		1993	12,000	667	Westslope CT	
		1992	8,440	469	Kamloops RBT	
Lake Mountain (a.k.a. Cuttoff) (01-104)	2.0	1999	1,750	875	Westslope CT	
		1997	1,750	875	Westslope CT	
		1995	1,750	875	Westslope CT	
West Fork Lake (01-109)	4.5	1999	3,000	667	Kamloops RBT	
		1998	3,000	667	Westslope CT	
		1997	3,000	667	Westslope CT	
		1996	1,750	389	Westslope CT	
		1995	3,000	667	Westslope CT	
		1994	3,000	667	Westslope CT	
		1993	3,000	667	Kamloops RBT	
		1992	3,000	667	Westslope CT	
Long Mountain L. (01-112)	0.8	1999	1,500	1,875	Grayling	
		1996	1,039	1,300	Golden trout	
		1995	1,500	1,875	Westslope CT	
		1993	1,500	1,875	Grayling	
		1992	664	830	Grayling	
Parker Lake (01-113)	1.9	1999	1,000	526	Grayling	
		1996	500	263	Grayling	
		1996	4,517	2,377	Golden trout	
		1995	1,000	526	Grayling	
		1993	1,042	548	Grayling	
		1992	265	140	Grayling	
Long Canyon (a.k.a. Smith) (01-115)	0.8	1999	1,500	1,875	Grayling	
		1997	980	1,225	Grayling	
		1995	3,000	3,750	Grayling	
		1993	704	880	Grayling	

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
KOOTENAI DRAINAGE (cont.)						
Big Fisher (01-117)	3.7	1998	2,500	676	Westslope CT	
		1996	2,500	676	Westslope CT	
		1994	2,500	676	Westslope CT	
		1992	2,500	676	Westslope CT	
Myrtle Lake (01-122)	8.1	1999	5,000	617	Westslope CT	
		1997	5,000	617	Westslope CT	
		1995	5,000	617	Westslope CT	
		1993	5,000	617	Westslope CT	
Trout Lake (01-124)	2.7	1998	1,750	648	Kamloops RBT	
		1994	1,750	648	Kamloops RBT	
		1992	1,750	648	Kamloops RBT	
Pyramid Lake (01-125)	3.0	1999	2,750	917	Kamloops RBT	
		1998	2,750	917	Westslope CT	
		1997	2,750	917	Kamloops RBT	
		1996	2,750	917	Westslope CT	
		1995	4,000	1,333	Westslope CT	
		1994	1,750	583	Westslope CT	
		1993	2,800	933	Kamloops RBT	
		1992	2,750	917	Westslope CT	
Ball Lake (01-126)	2.7	1998	1,500	555	Westslope CT	
		1996	1,500	555	Westslope CT	
		1994	1,000	370	Westslope CT	
		1992	1,500	555	Westslope CT	
Little Ball Lake (01-127)	0.8	1998	1,000	1,430	Westslope CT	
		1996	1,000	1,430	Westslope CT	
		1994	1,500	2,143	Westslope CT	
		1992	1,000	1,430	Westslope CT	
Snow Lake (01-134)	3.6	1999	2,500	694	Westslope CT	
		1997	2,500	694	Westslope CT	
		1995	2,500	694	Westslope CT	
		1993	2,500	694	Westslope CT	
Roman Nose L. #1 (01-135)	6.6	1993	390	59	Bull trout	-- Stocked experimentally for brook trout control

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
KOOTENAI DRAINAGE (cont.)						
Roman Nose L. #2 (01-136)	3.3	1993	162	49	Bull trout	Brook trout control
		1996	3,000	909	Westslope CT	Stocked by mistake
Roman Nose L. #3 (01-137)	4.8	1999	3,000	625	Kamloops RBT	
		1998	3,000	625	Kamloops RBT	
		1997	3,000	625	Kamloops RBT	
		1996	3,000	625	Westslope CT	
		1995	3,000	625	Westslope CT	
		1994	3,772	786	Westslope CT	
		1993	3,000	625	Kamloops RBT	
		1992	1,300	271	Westslope CT	
Queen Lake (01-148)	1.0	1998	1,250	1,250	Westslope CT	
		1996	1,265	1,265	Westslope CT	
		1992	1,250	1,250	Westslope CT	
Debt Lake (01-150)	0.5	1999	1,250	2,500	Westslope CT	
		1997	1,260	2,500	Westslope CT	
		1995	1,250	2,500	Westslope CT	
		1993	1,250	2,500	Westslope CT	
Spruce Lake (01-154)	2.6	1999	1,250	480	Kamloops RBT	
		1998	1,250	480	Westslope CT	
		1997	1,250	480	Kamloops RBT	
		1996	1,250	480	Westslope CT	
		1995	1,250	480	Westslope CT	
		1994	1,250	480	Westslope CT	
		1993	1,250	480	Kamloops RBT	
		1992	1,250	480	Westslope CT	
Copper Lake (01-155)	0.5	1998	1,250	2,500	Westslope CT	
		1996	1,250	2,500	Westslope CT	
		1994	1,360	2,720	Westslope CT	
		1992	1,250	2,500	Westslope CT	
Callahan Lake (a.k.a. Smith Lake) (01-160)	3.2	1999	2,500	781	Grayling	Stocking ceased in 1996 due to concern for Redband RB. Resumed with grayling.
		1995	2,500	781	Westslope CT	
		1993	2,500	781	Westslope CT	
		1992	2,500	781	Westslope CT	

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
KOOTENAI DRAINAGE (cont.)						
Estelle Lake (01-167)	1.7		A total of 1,725 Brown trout stocked from 1988-1992 for experimental brook trout control			
PEND OREILLE DRAINAGE						
Hunt Lake	5.6	1999	3,000	536	Westslope CT	
(02-101)		1998	3,000	536	Westslope CT	
		1997	3,000	536	Westslope CT	
		1996	3,000	536	Westslope CT	
		1995	3,000	536	Westslope CT	
		1994	3,000	536	Westslope CT	
		1993	3,000	536	Westslope CT	
		1992	3,000	536	Westslope CT	
Standard Lake	2.4	1999	4,000	1,667	Westslope CT	
(02-103)		1997	4,000	1,667	Westslope CT	
		1995	4,000	1,667	Westslope CT	
		1993	4,000	1,667	Westslope CT	
Two Mouth Lake #2	1.5	1999	1,250	833	Westslope CT	
(02-107)		1997	1,250	833	Westslope CT	
		1995	1,250	833	Westslope CT	
		1993	1,325	883	Westslope CT	
Two Mouth Lake #3	1.6	1998	5,000	3,125	Westslope CT	
(02-108)		1996	5,000	3,125	Westslope CT	
		1994	5,000	3,125	Westslope CT	
		1992	5,000	3,125	Westslope CT	
Mollies Lake	0.8	1999	500	625	Westslope CT	
(02-114)		1997	858	1,072	Westslope CT	
		1993	500	625	Westslope CT	
Caribou Lake	3.9	1998	1,750	450	Westslope CT	Quit stocking in
(near West Fork		1996	3,000	770	Westslope CT	1999 because of
Mtn)		1994	1,750	450	Westslope CT	high brook trout
(02-116)		1992	1,750	450	Westslope CT	abundance.
Fault Lake	2.3	1999	1,500	652	Westslope CT	
(a.k.a. Hunt Peak		1997	1,500	652	Westslope CT	
#1)		1995	1,500	652	Westslope CT	
(02-121)		1993	1,500	652	Westslope CT	

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
PEND OREILLE DRAINAGE (cont.)						
McCormick Lake	1.1	1999	775	705	Westslope CT	
(a.k.a. Hunt Peak		1997	775	705	Westslope CT	
#2)		1993	775	705	Westslope CT	
(02-122)						
Little Harrison Lake	2.6	1996	1,620	623	Westslope CT	
(02-126)		1994	1,620	623	Westslope CT	
		1992	1,620	623	Westslope CT	
Beehive Lake	2.3	1999	1,750	760	Westslope CT	
(02-128)		1997	1,750	760	Westslope CT	
		1995	1,800	783	Westslope CT	
		1993	1,750	760	Westslope CT	
Harrison Lake	11.7	1999	7,250	620	Westslope CT	
(02-129)		1998	7,275	622	Westslope CT	
		1997	7,275	622	Westslope CT	
		1996	7,275	622	Westslope CT	
		1995	7,266	621	Westslope CT	
		1994	7,250	620	Westslope CT	
		1993	7,250	620	Westslope CT	
		1992	7,250	620	Westslope CT	
Beaver Lake (02-130)	2.0		A total of 750 brown trout stocked from 1990-1992 for experimental brook trout control			
Dennick Lake	3.2	1999	2,500	781	Westslope CT	
(02-171)		1998	2,000	625	Westslope CT	
		1997	2,000	625	Westslope CT	
		1996	2,000	625	Westslope CT	
		1995	2,000	625	Westslope CT	
		1994	2,000	625	Westslope CT	
		1992	150	47	Brown trout	USFS stocked
		1992	2,000	625	Westslope CT	brown trout by mistake
Sand Lake	2.0	1999	1,250	625	Westslope CT	
(02-172)		1998	1,250	625	Westslope CT	
		1997	1,250	625	Westslope CT	
		1996	1,250	625	Westslope CT	
		1995	1,250	625	Westslope CT	
		1994	1,250	625	Westslope CT	
		1993	1,025	512	Westslope CT	
		1992	1,250	625	Westslope CT	

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
PEND OREILLE DRAINAGE (cont.)						
Porcupine Lake (02-182)	4.5	1998	1,022	227	Kamloops RBT	Catchables
		1997	1,035	230	Kamloops RBT	catchables
		1994	303	68	Hayspur RBT	catchables
		1993	387	86	Kamloops RBT	catchables
Moose Lake (02-185	6.4		A total of 6,515 brown trout stocked from 1987-1992 for experimental brook trout control			
Antelope Lake (02-190)	6.5	1999	175	27	Grayling	adults
		1999	4,513	694	Kamloops RBT	catchables
		1998	5,027	773	Kamloops RBT	catchables
		1997	5,150	792	Kamloops RBT	catchables
		1997	2,111	325	Brook trout	Surplus fingerlings
		1996	1,000	154	Westslope CT	Broodstock
		1996	3,050	469	Rainbow trout	catchables
		1995	2,834	436	Hayspur RBT	catchables
		1994	1,000	154	Hayspur RBT	catchables
		1993	1,387	213	Hayspur RBT	catchables
		1992	1,363	210	Hayspur RBT	catchables
Caribou Lake (near Keokee Mtn.) (02-196)	2.8	1998	1,700	607	Westslope CT	
		1997	1,300	464	Westslope CT	
		1996	1,700	607	Westslope CT	
		1994	1,700	607	Westslope CT	
		1993	1,700	607	Westslope CT	
		1992	1,700	607	Westslope CT	
SPOKANE DRAINAGE						
Elsie Lake (03-119)	6.3	1999	3,377	536	Kamloops RBT	catchables
		1998	3,018	479	Kamloops RBT	catchables
		1997	2,526	400	Kamloops RBT	catchables
		1996	1,012	161	Kamloops RBT	catchables
		1995	4,042	642	Hayspur RBT	catchables
		1994	2,264	359	Hayspur RBT	catchables
		1993	4,045	642	Hayspur RBT	catchables

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
SPOKANE DRAINAGE (cont.)						
		1992	4,020	638	Hayspur RBT	Catchables
Lower Glidden Lake (03-123)	5.7	1999	3,296	578	Kamloops RBT	catchables
		1998	3,000	526	Kamloops RBT	catchables
		1997	2,517	442	Kamloops RBT	catchables
		1996	4,032	707	Kamloops RBT	catchables
		1995	4,042	709	Hayspur RBT	catchables
		1994	2,212	388	Hayspur RBT	catchables
		1993	4,005	703	Hayspur RBT	catchables
		1992	3,534	620	Hayspur RBT	catchables
Upper Glidden Lake (03-124)	7.5	1993	180	24	Bull trout	Experimental brook trout control
Gold Lake (03-125)	1.2	Discontinued stocking in 1994 because of winterkill. Need to resume stocking and evaluate frequency of winterkills.				
Revett Lake (03-130)	8.4	1993	309	37	Bull trout	Experimental brook trout control
Crater Lake (03-133)	1.5	1999	2,500	1,667	Grayling	Reserve for grayling
		1997	1,500	1,000	Grayling	
		1996	3,100	2,067	Grayling	
		1995	1,750	1,167	Grayling	
		1993	2,500	1,667	Grayling	
Dismal Lake (03-138)	2.6	1999	300	115	Kamloops RBT	catchables
		1998	270	104	Kamloops RBT	catchables
		1997	252	97	Kamloops RBT	catchables
		1996	250	96	Kamloops RBT	catchables
		1995	252	97	Kamloops RBT	catchables
		1994	265	102	Hayspur RBT	catchables
		1993	230	88	Hayspur RBT	catchables
		1992	250	96	Hayspur RBT	catchables

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
SPOKANE DRAINAGE (cont.)						
Bacon Lake (03-144)	3.6	1999	2,250	625	Westslope CT	
		1997	2,250	625	Westslope CT	
		1995	2,250	625	Westslope CT	
		1993	2,250	625	Westslope CT	
Forage Lake	2.9	1999	2,000	690	Golden trout	
(03-146)		1997	700	240	Grayling	
		1996	3,250	1,120	Grayling	
		1995	670	231	Grayling	
		1993	3,250	1,120	Grayling	
		1992	600	207	Grayling	
Halo Lake	4.0	1999	3,000	750	Westslope CT	
(03-147)		1997	3,000	750	Westslope CT	
		1995	3,118	780	Westslope CT	
		1993	3,000	750	Westslope CT	
Crystal Lake	4.1	1999	2,500	610	Westslope CT	
(03-160)		1997	2,500	610	Westslope CT	
		1995	2,500	610	Westslope CT	
		1993	2,500	610	Westslope CT	
CLEARWATER DRAINAGE						
Devils Club Lake	1.2	1998	1,000	833	Westslope CT	
(06-113)		1996	1,000	833	Westslope CT	
		1992	1,000	833	Westslope CT	
Big Talk Lake	2.1	1998	2,500	1,190	Westslope CT	
(06-114)		1996	2,500	1,190	Westslope CT	
		1992	2,500	1,190	Westslope CT	
Larkins Lake	3.3	1998	3,000	910	Westslope CT	
(06-117)		1996	3,000	910	Westslope CT	
Mud Lake (06-118)	1.9	1999	1,500	790	Kamloops RBT	
		1997	1,500	790	Kamloops RBT	
		1995	1,500	790	Trout Lk RBT	
		1993	1,500	790	Hayspur RBT	
Hero Lake	2.0	1998	1,000	500	Westslope CT	
(06-119)		1996	1,500	750	Westslope CT	
		1992	1,500	750	Westslope CT	

Appendix A. Continued.

Lake (code)	Surface area	Year stocked	Number stocked	Density (fish/ha)	Stock of fish	Comments
CLEARWATER DRAINAGE						
Heart Lake (06-122)	13.4	1998	10,000	746	Kamloops RBT	
		1996	10,000	746	Kamloops RBT	
		1994	3,865	288	Kamloops RBT	
		1992	10,000	746	Mt. Lassen RBT	
Northbound Lake (06-123)	4.7	1998	3,000	638	Westslope CT	
		1996	3,000	638	Westslope CT	
		1994	500	106	Westslope CT	
		1992	3,000	638	Westslope CT	
Skyland Lake (06-125)	5.4	1999	3,250	602	Kamloops RBT	
		1997	3,250	602	Kamloops RBT	
		1995	3,250	602	Trout Lk RBT	
		1993	3,250	602	Hayspur RBT	
Fawn Lake (06-126)	4.9	1998	3,250	663	Westslope CT	
		1996	3,250	663	Westslope CT	
		1992	3,250	663	Westslope CT	
Noseeum Lake (06-130)	1.9	1999	1,000	526	Westslope CT	
		1997	1,000	526	Westslope CT	
		1995	1,000	526	Westslope CT	
		1993	1,000	526	Westslope CT	
Steamboat Lake (06-131)	2.9	1999	4,500	1,550	Grayling	Reserve for grayling
		1997	2,700	931	Grayling	
		1996	5,135	1,770	Grayling	
		1995	3,000	1,035	Grayling	
		1993	4,500	1,550	Grayling	

Appendix B. Primary and secondary drainages, size (ha), elevation (m), and location of all lakes above 1,000 m with a surface area of at least 0.5 ha in Idaho's Panhandle Region.

Primary drainage	Lake	Secondary drainage	Area (ha)	Elevation	Longitude x latitude (UTM)	Quadrangle	Stocked Y/N
Clark Fork	Still Lake	Lightning Creek	0.8	1347	56392 x 53435	Clark Fork	
Clark Fork	Blacktail Lake	Lightning Creek	1.5	1689	56402 x 53546	Trestle Peak	
Clark Fork	Gem Lake	Lightning Creek	2.6	1760	56450 x 53685	Mt. Pend Oreille	
Clark Fork	Porcupine Lake	Lightning Creek	4.5	1457	56040 x 53433	Clark Fork	Y
Clark Fork	Lake Darling	Lightning Creek	4.6	1607	56220 x 53614	Mt. Pend Oreille	
Clark Fork	Moose Lake	Lightning Creek	6.4	1657	56690 x 53558	Benning Mtn.	
Coeur d'Alene	no name	Beaver Creek	0.7	1720	59560 x 52626	Thompson Pass	
Coeur d'Alene	Lower Glidden L.	Canyon Creek	5.7	1709	59535 x 52632	Thompson Pass	Y
Coeur d'Alene	Upper Glidden L.	Canyon Creek	7.5	1797	59646 x 52633	Thompson Pass	
Coeur d'Alene	no name	East Fork Big Creek	0.5	1707	57418 x 52527	Polaris Peak	
Coeur d'Alene	no name	East Fork Big Creek	0.6	1597	57355 x 52535	Polaris Peak	
Coeur d'Alene	Elsie Lake	East Fork Big Creek	6.3	1545	57325 x 52538	Polaris Peak	Y
Coeur d'Alene	Lost Lake	Lake Creek	2.6	1530	57538 x 52563	Wallace	
Coeur d'Alene	Mirror Lake	Latour Creek	0.6	1756	54875 x 52236	Twin Crags	
Coeur d'Alene	Crystal Lake	Latour Creek	4.1	1622	54635 x 52470	Rochat Lake	Y
Coeur d'Alene	Revett Lake	Prichard Creek	8.4	1719	59390 x 52860	Burke	Y
Coeur d'Alene	no name	Willow Creek	1.5	1694	58859 x 52539	Mullan	
Coeur d'Alene	Loon Lake	Willow Creek	2.2	1698	59250 x 52539	Mullan	
Coeur d'Alene	Upper Stevens Lake	Willow Creek	4.8	1749	59360 x 52533	Mullan	
Coeur d'Alene	Lower Stevens Lake	Willow Creek	11.4	1688	59340 x 52935	Mullan	
Kootenai	Little Ball Lake	Ball Creek	0.6	2013	52985 x 54039	Pyramid Lake	Y
Kootenai	Ball Creek Lake	Ball Creek	2.7	2045	52995 x 54043	Pyramid Lake	Y
Kootenai	Kent Lake	Ball Creek	5.7	1720	52477 x 53969	The Wigwams	
Kootenai	Myrtle Lake	Ball Creek	8.1	1812	52782 x 54010	Pyramid Lake	Y
Kootenai	no name	Boulder Creek	0.6	1646	56187 x 53743	Clifty Mtn.	
Kootenai	Search Lake	Boundary Creek	0.9	1707	51348 x 54184	Grass Mtn.	
Kootenai	Joe Lake	Boundary Creek	1.5	1703	51654 x 54148	Grass Mtn.	

Appendix B. Continued.

Primary drainage	Lake	Secondary drainage	Area (ha)	Elevation	Longitude x latitude (UTM)	Quadrangle	Stocked Y/N
Kootenai	Marsh Lake	Boundary Creek	1.8	1755	51560 x 54208	Grass Mtn.	
Kootenai	Hidden Lake	Boundary Creek	18.0	1659	51800 x 54145	Grass Mtn.	Y
Kootenai	Canyon Lake	Canyon Creek	1.0	1790	52790 x 54165	Shorty Peak	
Kootenai	Roman Nose #1	Caribou Creek	6.6	1888	53070 x 53866	Roman Nose	
Kootenai	Roman Nose #2	Caribou Creek	3.3	1805	53020 x 53874	Roman Nose	
Kootenai	Roman Nose #3	Caribou Creek	4.8	1796	53145 x 53865	Roman Nose	Y
Kootenai	Debt Lake	Debt Creek	0.5	1746	56200 x 53872	Moyie Springs	Y
Kootenai	Parker Lake	Long Canyon Creek	1.9	1926	52957 x 54121	Pyramid Lake	Y
Kootenai	no name	Moyie R	1.1	1756	56935 x 54030	Line Point	
Kootenai	Solomon Lake	Moyie R	4.6	1024	56525 x 54052	Line Point	Y
Kootenai	Copper Lake	Moyie River	0.5	1804	56561 x 54269	Canuck Peak	Y
Kootenai	Queen Lake	Moyie River	1.0	1711	55835 x 54148	Eastport	Y
Kootenai	Spruce Lake	Moyie River	2.6	1660	56504 x 54185	Canuck Peak	Y
Kootenai	no name	Myrtle Creek	0.5	1097	54118 x 53874	Moravia	
Kootenai	no name	Myrtle Creek	0.6	1917	52534 x 53939	The Wigwams	
Kootenai	no name	Myrtle Creek	0.9	1712	52875 x 53984	Roman Nose	
Kootenai	no name	Myrtle Creek	1.1	1113	54389 x 53878	Moravia	
Kootenai	no name	Myrtle Creek	1.2	1113	54382 x 53878	Moravia	
Kootenai	Cooks Lake	Myrtle Creek	2.7	1768	53070 x 52939	Roman Nose	
Kootenai	Brooks Lake	Myrtle Creek	3.2	1806	52850 x 53930	Roman Nose	
Kootenai	Callahan Lake	Callahan Creek	3.2	1732	56550 x 53642	Smith Mtn.	Y
Kootenai	Long Mtn. Lake	Parker Creek	0.8	2044	52835 x 54087	Pyramid Lake	Y
Kootenai	Big Fisher Lake	Parker Creek	3.7	2052	53120 x 54095	Pyramid Lake	Y
Kootenai	Smith Lake	Smith Creek	1.9	1936	52305 x 54097	Smith Peak	Y
Kootenai	Cutoff Lake	Smith Creek	2.0	1886	52360 x 54110	Smith Peak	Y
Kootenai	West Fork Lake	Smith Creek	4.5	1759	51855 x 54091	Smith Peak	Y
Kootenai	no name	Snow Creek	0.5	1780	52996 x 53891	Roman Nose	
Kootenai	Snow Lake	Snow Creek	3.4	1805	52915 x 53877	Roman Nose	Y

Appendix B. Continued.

Primary drainage	Lake	Secondary drainage	Area (ha)	Elevation	Longitude x latitude (UTM)	Quadrangle	Stocked Y/N
Kootenai	Bottleneck Lake	Snow Creek	4.4	1714	52962 x 53893	Roman Nose	
Kootenai	Trout Lake	Trout Creek	2.7	1844	53075 x 54074	Pyramid Lake	Y
Kootenai	Pyramid Lake	Trout Creek	3.2	1844	52805 x 54051	Pyramid Lake	Y
Kootenai	Lake Estelle	Callahan Creek	1.7	1757	56568 x 53594	Smith Mtn.	
LNFCR	Lost Lake	Lost Lake Creek	10.4	1687	57980 x 52136	Widow Mtn	
LNFCR	No-See-Um Lake	Butte Creek	1.9	1682	59200 x 52080	Monumental Buttes	Y
LNFCR	Dismal Lake	Butte Creek	2.6	1634	60340 x 52189	Montana Peak	Y
LNFCR	Steamboat Lake	Butte Creek	2.9	1804	59110 x 52083	Monumental Buttes	Y
LNFCR	no name	Butte Creek	1.7	1219	58740 x 52160	Monumental Buttes	
LNFCR	no name	Butte Creek	0.7	1256	58709 x 52157	Monumental Buttes	
LNFCR	no name	Butte Creek	0.4	1280	58790 x 52165	Monumental Buttes	
LNFCR	Devil's Club Lake	Devil's Club Creek	1.2	1573	60360 x 52011	Buzzard Roost	Y
LNFCR	Little Lost Lake	Little Lost L. Creek	1.3	1757	58060 x 52128	Widow Mtn.	
LNFCR	no name	LNFCR	0.7	1853	57793 x 52151	Widow Mtn.	
LNFCR	Fish Lake	LNFCR	2.2	1654	57830 x 52167	Widow Mtn.	
LNFCR	Northbound Lake	Sawtooth Creek	4.7	1657	60825 x 51992	Mallard Peak	Y
LNFCR	Black Lake	Sawtooth Creek	1.3	1951	61027 x 51925	Mallard Peak	
LNFCR	Gnat Lake	Sawtooth Creek	1.5	1782	60600 x 52018	Mallard Peak	
LNFCR	Mud Lake	Sawtooth Creek	1.9	1792	60699 x 52011	Mallard Peak	Y
LNFCR	Hero Lake	Sawtooth Creek	2.0	1585	60610 x 52023	Mallard Peak	Y
LNFCR	Crag Lake	Sawtooth Creek	3.0	1792	60785 x 52003	Mallard Peak	
LNFCR	Larkins Lake	Sawtooth Creek	3.3	1707	60540 x 52004	Mallard Peak	Y
LNFCR	Fawn Lake	Sawtooth Creek	4.9	1823	61230 x 52014	Mallard Peak	Y
LNFCR	Skylard Lake	Sawtooth Creek	5.4	1463	61148 x 52005	Mallard Peak	Y
LNFCR	Heart Lake	Sawtooth Creek	13.4	1859	60735 x 51994	Mallard Peak	Y
LNFCR	Big Talk Lake	Foehl Creek	2.1	1654	59050 x 52044	Little Goat Mtn.	Y
Pack River	Caribou Lake	Caribou Creek	2.8	1583	52435 x 53643	Mt. Casey	Y
Pack River	Keokee Lake	Caribou Creek	2.3	1694	52550 x 53630	Mt. Casey	
Pack River	no name	McCormick Creek	0.6	1802	52260 x 53832	Mt. Roothan	
Pack River	McCormick Lake	McCormick Creek	1.1	1851	52220 x 53781	Mt. Roothan	Y

Appendix B. Continued.

Primary drainage	Lake	Secondary drainage	Area (ha)	Elevation	Longitude x latitude (UTM)	Quadrangle	Stocked Y/N
Pack River	Fault Lake	McCormick Creek	2.3	1823	52255 x 53785	Mt. Roothan	Y
Pack River	no name	McCormick Creek	1.5	2036	52217 x 53809	Mt. Roothan	
Pend Oreille	Beehive Lake #2	Beehive Creek	2.5	1968	52550 x 53891	The Wigwams	Y
Pend Oreille	Kilroy Lake #1	Kilroy Creek	0.7	1158	54640 x 53297	Packsaddle Mtn.	
Kootenai	no name	Boulder Creek	0.6	1646	56187 x 53743	Clifty Mtn.	
Kootenai	Search Lake	Boundary Creek	0.9	1707	51348 x 54184	Grass Mtn.	
Kootenai	Joe Lake	Boundary Creek	1.5	1703	51654 x 54148	Grass Mtn.	
Pend Oreille	Kilroy Lake #2	Kilroy Creek	1.0	1158	54618 x 53297	Packsaddle Mtn.	
Pend Oreille	Beehive Lake #1	Pack River	2.3	1911	52560 x53897	The Wigwams	
Pend Oreille	no name	Pack River	2.4	1122	55234 x 53653	Wylie Knob	
Pend Oreille	Harrison Lake	Pack River	11.7	1884	52560 x 53917	The Wigwams	Y
Pend Oreille	Little Harrison	Pack River	2.6	1866	52250 x 53907	The Wigwams	Y
Priest River	no name	Caribou Creek	0.6	1640	51652 x 54116	Caribou Creek	
Priest River	Caribou Lakes #3	Caribou Creek	0.7	1711	51743 x 54033	Caribou Creek	
Priest River	Caribou Lakes #1	Caribou Creek	0.7	1779	51710 x 54102	Caribou Creek	
Priest River	Mollies Lake	Caribou Creek	0.8	1685	51240 x 54107	Caribou Creek	Y
Priest River	Lookout Lake	Caribou Creek	1.1	1696	51679 x 54027	Caribou Creek	
Priest River	Caribou Lakes #2	Caribou Creek	3.9	1690	51746 x 54097	Caribou Creek	
Priest River	Hunt Lake	Hunt Creek	5.6	1772	52106 x 53805	Mt. Roothan	Y
Priest River	Two Mouth Lake #2	Two Mouth Creek	1.5	1777	52552 x 53949	The Wigwams	Y
Priest River	Two Mouth Lake #3	Two Mouth Creek	1.6	1927	52500 x 53933	The Wigwams	
Priest River	Standard Lake #2	Two Mouth Creek	2.4	1555	52195 x 53920	The Wigwams	
Priest River	Two Mouth Lake	Two Mouth Creek	3.2	1781	52695 x 53947	The Wigwams	Y
Priest River	Standard Lake #1	Two Mouth Creek	5.3	1621	52101 x 53921	The Wigwams	Y
St. Joe	no name	Bacon Creek	0.8	1725	63082 x 52023	Bacon Peak	
St. Joe	no name	Bacon Creek	1.1	1926	63298 x 52023	Bacon Peak	
St. Joe	no name	Canyon Creek	0.5	1719	60434 x 52116	Bathtub Mtn.	
St. Joe	Halo Lake	Dump Creek	4.0	1865	63270 x 52039	Bacon Peak	Y
St. Joe	Forage Lake	Forage Creek	2.9	1756	63160 x 52041	Bacon Peak	Y
St. Joe	no name	Gold Creek	0.7	1682	63085 x 52177	Red Ives Peak	

Appendix B. Continued.

Primary drainage	Lake	Secondary drainage	Area (ha)	Elevation	Longitude x latitude (UTM)	Quadrangle	Stocked Y/N
St. Joe	Crater Lake	Marble Creek	1.5	1756	57676 x 52094	Widow Mtn.	Y
St. Joe	Theiault Lake	Marble Creek	1.8	1747	57346 x 52226	Marble Mtn.	
St. Joe	no name	Mica Creek	0.5	1017	56414 x 52199	Huckleberry Mtn.	
St. Joe	no name	North Fork St. Joe	0.6	1731	59978 x 52404	Shefoot Mtn.	
St. Joe	no name	Simmons Creek	1.3	1960	63716 x 52192	Sherlock Peak	
St. Joe	St. Joe Lake	St. Joe River	7.8	1654	64500 x 52087	Illinois Peak	
St. Joe	Crow Lake	Fishhook Creek	2.1	1768	58142 x 52181	Widow Mtn.	
St. Joe	no name	Gold Creek	1.1	1902	62945 x 52170	Red Ives Peak	
St. Joe	Swimming Bear L.	Gold Creek	1.2	1902	62828 x 52184	Red Ives Peak	
St. Joe	no name	Marble Creek	0.5	1824	57810 x 52107	Widow Mtn.	

Appendix C. Overview of individual lakes surveyed in the 1999 mountain lakes assessment including access, campsites, level of use, physical characteristics, and fisheries assessments.

Caribou Lake
(Priest Lake drainage)

Survey Date: August 17-18, 1999
Stocking number 02-016 (Priest Lake Drainage)
Sample Crew Leader: Jim Fredericks

Caribou Lake is the largest of three lakes at the headwaters of Caribou Creek, a tributary to the Thorofare between Upper Priest and Priest lakes. To our knowledge, the lake had not been surveyed prior to this effort. The lake is about 3.9 hectares and is a moderately deep cirque lake with a northwest exposure. We estimated mean depth at about 4-5 m and maximum depth at 6.5 m. Limnologically, the lake is not nutrient rich, with a surface conductivity of only 4.2 μmhos on the date surveyed and total dissolved solids were around 10 mg/L. Secchi disk visibility was greater than maximum depth of the lake.

Caribou Lake is accessed by a poorly maintained trail from West Fork Lake. Two to three older campsites are available, but indicate fairly light use. There is no complete trail around the lake, and the southeast bank is steep and brushy. Shoreline fishing access is fair.

We collected 34 brook trout and one cutthroat trout in an overnight floating gill net. Fish ranged from 190 to 260 mm in length (7 to 10 inches; see Figure 1) and 90-180 g in weight. Condition factor averaged 1.06. There is virtually no spawning habitat in the inlet(s), which are cascading, intermittent streams. The outlet has approximately 40 meters of fair quality spawning habitat, which is evidently enough to support a strong brook trout population. Historically, Caribou Lake has been stocked on alternate years with around 175 cutthroat trout fry per hectare. Based on the abundance of brook trout and the lack of cutthroat trout in the gill net catch, we recommended discontinuing cutthroat trout stocking. We did not fish Caribou Lake, but saw lots of fish rising. We saw numerous tadpoles of Columbia-Spotted Frogs. Aquatic insects noted were mosquitoes and black flies.

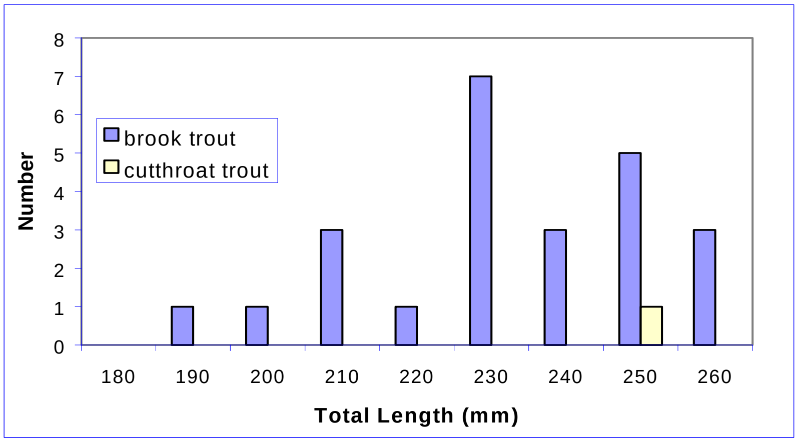


Figure 1. Length frequency distribution of brook trout and cutthroat trout collected from Caribou Lake, Panhandle Region, Idaho, in the 1999 survey.

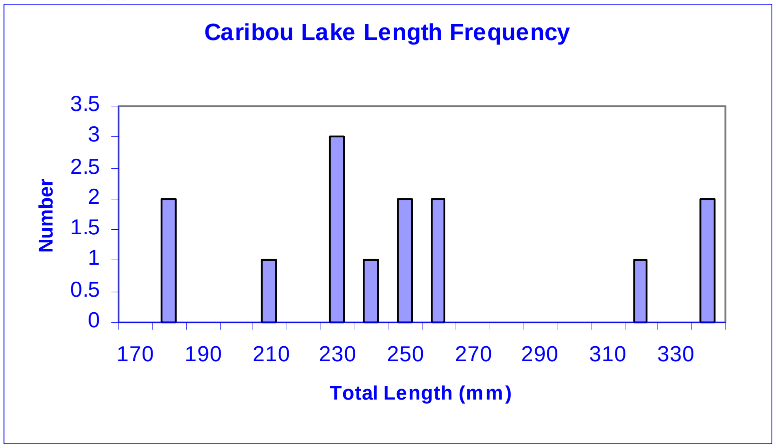
Appendix C. Continued.

Caribou Lake
(Pack River drainage)

Survey Date: August 30-31, 1999
Stocking number 02-196 (Pack River Drainage)
Sample Crew Leader: John Phillips

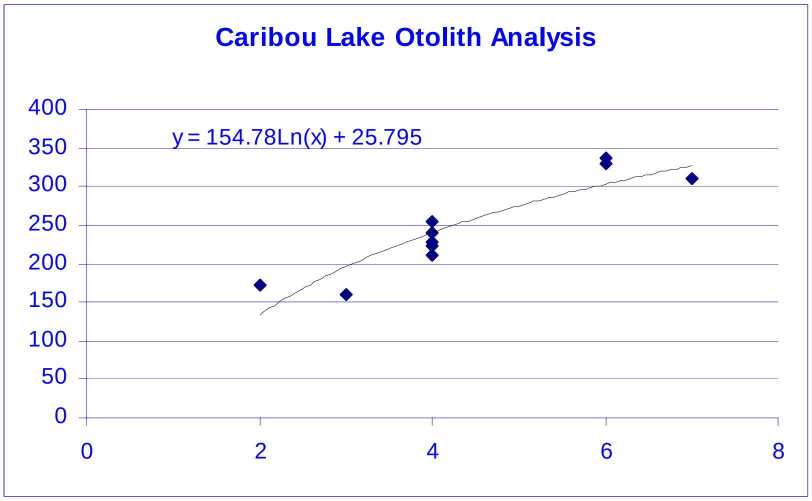
Note: A detailed USFS survey of the lake was completed in 1979.

Caribou Lake is an approximately 2.8 ha, moderately deep cirque lake in the Pack River drainage. The lake is accessed by an approximately 4½ mile, good quality trail. A 4WD road was historically open for the first 3½ miles of what is now the trail. The road closure has apparently reduced use since the 1979 USFS survey (although horse packing use may have increased). Shoreline access is limited. Steep, brushy sides surround the lake. There is some fishing opportunity from boulders around the lake



We collected 14 westslope cutthroat trout in an overnight gill net set. Fish ranged from 170-335 mm in length and 62-420 g in weight. Condition factor ranged from 0.83 to1.23 and averaged 1.01 indicating fair condition. Growth was fairly rapid, with fish achieving 250 mm in their fourth year on average. We found suitable spawning habitat in the outlet (not noted in 1979). We saw low to moderate fish activity during the survey. There were mayflies hatching and occasional fish rising. Catch rates of two anglers interviewed during the survey were about 3 fish/hour.

Historically the lake has been stocked annually with around 250 cutthroat fry per acre. Beginning in 2000, we will switch to an alternate year stocking (even years) and increase the rate to 750 fish/ha, for an alternate year total of 2,100 fry.



Appendix C. Continued.

Copper Lake

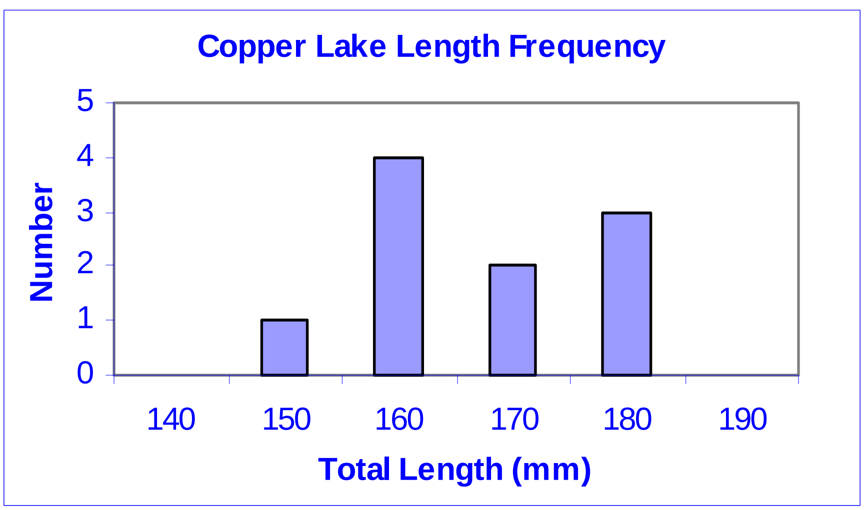
Survey Date: September 1-2, 1999
Stocking number 01-155
Sample Crew Leader: John Phillips

Copper Lake is an approximately 0.6 ha lake located at the headwaters of Copper Creek (a Moyie River tributary) about ½ mile from the Idaho/British Columbia border. The trail to Copper Lake in good condition and is about ½ mile in length. There is a seasonal road closure around 5 miles from the trail head (just past Canuck Pass). Therefore access is more difficult before the gate is opened in mid-summer. There is a good campsite with fire pit, which does not appear to be heavily used. Access around the lake is good, and the lake is easily fished from the shore.

Copper Lake is relatively shallow, with a maximum depth of around 6.5 m and mean depth of around 4 m. Copper Lake is not a nutrient rich environment. Surface water conductivity during the survey was 8.7 Φmhos/cm. Secchi disk visibility was 4.5 m, and total dissolved solids were less than 10 mg/L. Surface water temperature on September 2 was 15^{o}C.

We saw numerous Columbia spotted frogs and tadpoles during the survey. Insects included moderately abundant water skippers and mayflies. Littoral habitat was minimal, with some emergent vegetation, but no notable overhanging brush or woody debris along the shoreline.

We caught 10 westslope cutthroat trout during the survey, all by angling. Fish were abundant and catch rates were around 10 fish/hour. Fish ranged from 133 to 177 mm in length and from 17 to 65 g in weight. Condition factor averaged 1.04. Copper Lake has been stocked on alternate even years with around 1,250 cutthroat trout fry per year. Otolith analysis indicated that all fish were age-1 (stocked in 1998). The extended winter of 1996-97 and shallow profile of Copper Lake may have resulted in winter kill of fish stocked prior to 1998, explaining the lack of older age-classes of fish.



Prior stocking rates were based on an estimated surface area of 2 ha. In actuality, surface area is more likely about 0.7 ha. Therefore, based on the more accurate area estimates and the stocking guidelines developed in 1999-2000, stocking rate will be 600 fry per stocking event. Our recommendation following the 1999 survey is to continue to stock Copper Lake on an alternate year basis, stocking only on even years.

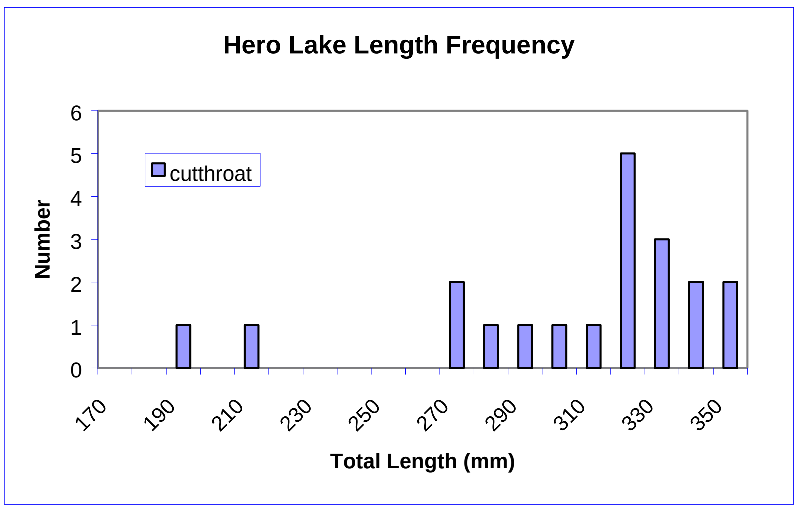
Appendix C. Continued.

Hero Lake

Survey Date: August 4, 1999
Stocking number 06-119
Sample Crew Leader: Jim Fredericks

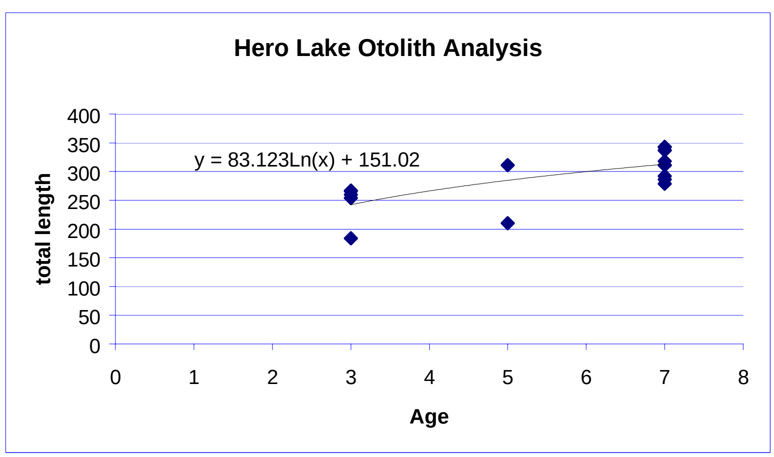
Hero Lake is an approximately 2.0 ha cirque lake located in the Mallard Larkins Wilderness Area. The lake is shallow, with a maximum depth of around 3 m. Hero Lake drains into Sawtooth Creek, within the Little North Fork Clearwater drainage. Access is difficult. The most direct route is from Sawtooth Saddle. The trail is approximately 10-11 km and is poorly maintained and difficult to follow in areas. The lake does not appear to receive much angling effort. We saw no evidence of recent angling activity. There is one large campsite about 50 m below the lake on the outlet stream (next to the trail). There is only a partial, poor quality trail around the lake. Because of the steep, brushy shoreline and abundance of floating logs, shoreline angling would be difficult.

Fish were abundant based on surface feeding activity and gill net catch. We collected 54 cutthroat trout in two overnight gill nets. Fish ranged from 184 to 343 mm in length (see figure) and from 75 to 510 g in weight. Condition factor averaged 1.11 indicating good condition. Based on otolith analysis and stocking records, cutthroat trout growth was good in Hero Lake with fish generally achieving 250 mm at age-3 and achieving 300 mm at age-5 (see figure).



We saw numerous caddis flies, dipterans, and odonates in larval and adult stages. We also saw moderate densities of amphibians. Columbia spotted-frog adults and larvae were abundant around the lake, and we saw several giant salamander larvae in the outlet stream.

In recent years, Hero Lake has been stocked with 500 cutthroat fry per hectare (1,000 total) on an alternate year basis. Based on new stocking guidelines that incorporate elevation and productivity, our recommendation is to increase stocking rates on Hero Lake to 750 fish/ha (1,500 total) on alternate years.

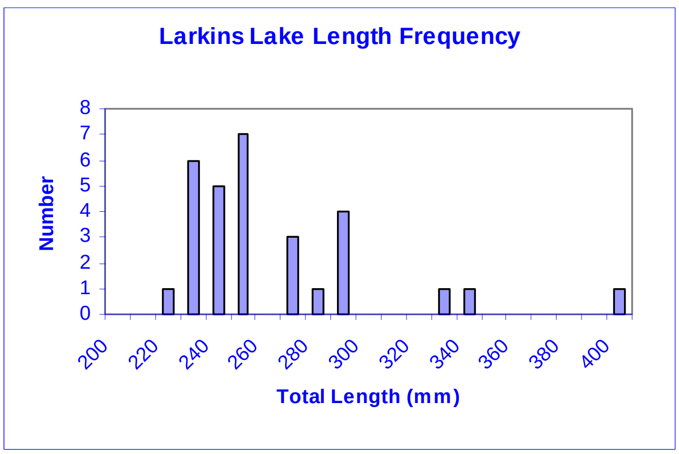


Appendix C. Continued.

Larkins Lake

Survey Date: August 4, 1999
Stocking number 06-117
Sample Crew Leader: Jim Fredericks

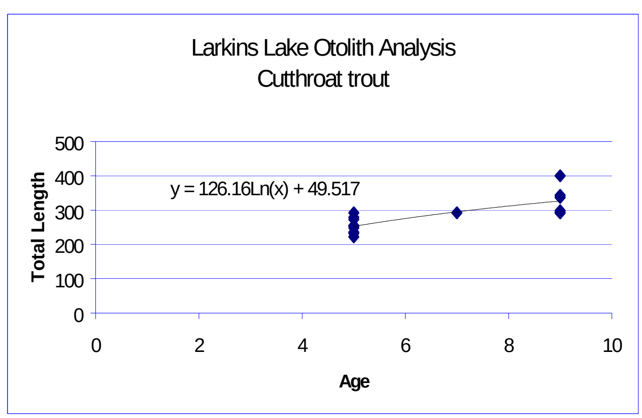
Larkins Lake is an approximately 3.2 ha cirque lake located in the Mallard Larkins Wilderness Area at the headwaters of Larkins Creek, a tributary to the Little North Fork of the Clearwater River. The lake can be found on the Mallard Peak quadrangle map. Larkins Lake is an exceptionally pretty lake with a steep, high peak forming the head end of the cirque. We saw numerous mountain goats from the lake. The lake is generally accessed from Smith Ridge, which entails a 8-9 km hike over a well-maintained trail. There are three to four campsites near the outlet of the lake and a partial trail around the lake. Larkins Lake is one of the first lakes hikers come to via the Smith Ridge trail. For this reason, as well as the beauty of the lake and the good quality fishery, Larkins Lake is one of the more heavily used lakes in the area. However, in comparison with other mountain lakes in the Idaho panhandle, use is still relatively low simply because of the hiking distance and remote nature of the wilderness area.



Based on gillnetting, angling, and observation, fish abundance in Larkins Lake was high in 1999. We caught 34 fish in a single, overnight gill net, and we caught 5-6 fish/h while angling. Netted fish ranged from 220 to 400 mm in length (see figure at left) and from 100 to 570 g in weight. Angled fish were mostly between 220 and 300 mm. Although we did not collect any fish under 200 mm, we saw numerous 100-150 mm fish cruising the shoreline. Condition factor averaged 0.96, indicating a slightly lower than average condition. Growth was moderate, with fish achieving 250 mm at around age-5 (see figure below). Despite the moderate growth rates, there were still numerous fish over 250 mm. The size structure combined with otolith analysis and stocking records indicates that cutthroat trout in Larkins Lake have excellent longevity and can live at least nine years.

We saw numerous aquatic and terrestrial insects in the area, with moderate abundance of black flies, mosquitoes, grasshoppers, and leafhoppers. There was a high abundance of Columbia spotted-frogs in larval and adult forms.

Based on the new stocking guidelines and growth rates, we recommend a reduction in stocking from 3,000 fry on alternate years (920 fish/ha) to 2,400 fry on alternate years (750 fish/ha).



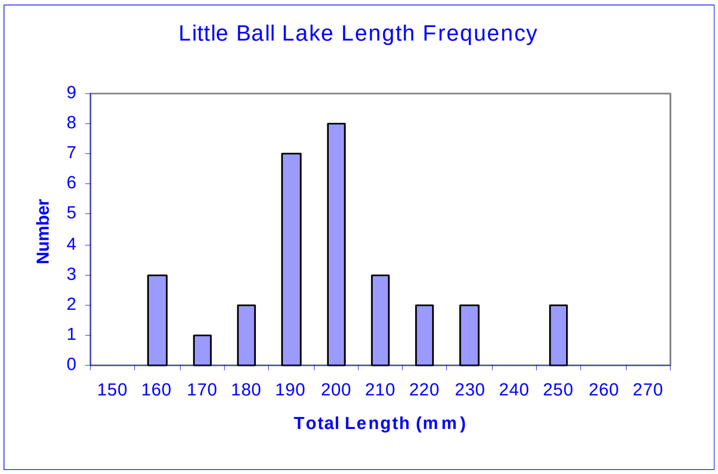
Appendix C. Continued.

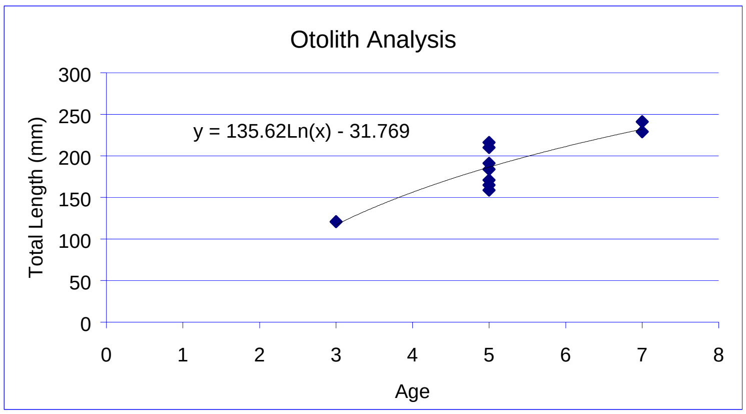
Little Ball Lake

Survey Date: July 20, 1999
Stocking number 01-127
Sample Crew Leader: Jim Fredericks

Little Ball Lake is a small (approximately 0.8 ha) cirque lake located at the headwaters of Ball Creek about 400 m from Ball Lake. Both lakes can be found on the Pyramid Lake quadrangle map. Little Ball Lake is accessed from the trailhead at the end of the Trout Creek road, and is approximately 3 km beyond Pyramid Lake. The trail is in good shape and the hike is relatively easy aside from the elevation gain. Little Ball Lake appears to receive a moderate amount of pressure. There was a single campsite and fire ring and not much litter. Unusual for late July, the lake was partially frozen during our survey, and the trail to the lake was mostly hidden by deep snow.

Based on gill net catch and the number of fish observed cruising the shoreline and in the outlet, fish abundance in Little Ball Lake was high. We collected 29 cutthroat trout in two overnight gill net sets ranging from 160 to 250 mm. Most fish were around 200 mm (see figure). Based on otolith analysis, the small size of the fish is likely related to very slow growth. Fish did not typically achieve 200 mm for almost six years. Little Ball Lake is a very oligotrophic and unproductive lake. Secchi disk visibility was much greater than the maximum depth, and specific conductance was only 4.7 μmhos. Little Ball Lake has historically been stocked with around 1,000 fish on an alternate year basis. This equates to a density of around 1,250 fish/ha, which is among the highest stocking rates in the region. Furthermore, we observed numerous fish spawning in the outlet of Little Ball Lake. The late timing of spawning suggests that natural reproduction is not likely very successful. However, 1999 was an exceptionally cool spring and early summer. In a warmer year, natural reproduction may well contribute to the already high stocking densities. Based on the slow growth rates, unproductive nature of the lake, and evidence of natural spawning, we recommend decreasing stocking rates to 400 cutthroat on alternate years (500/ha). Because we currently have no lakes stocked with grayling that are relatively easy to access, we recommend stocking 400 grayling rather than cutthroat trout when grayling are available.



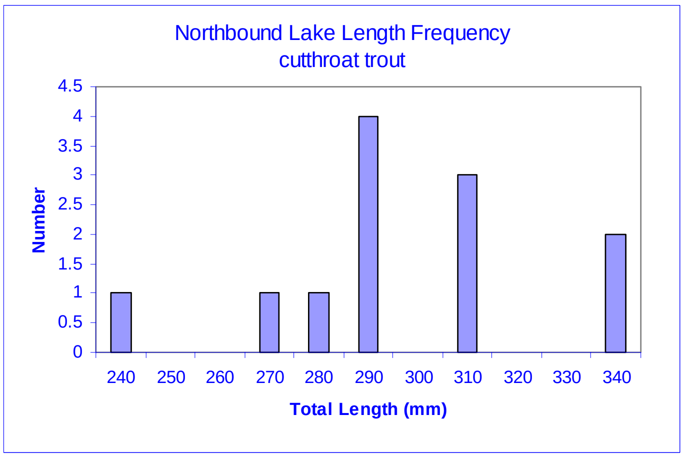


Appendix C. Continued.

Northbound Lake

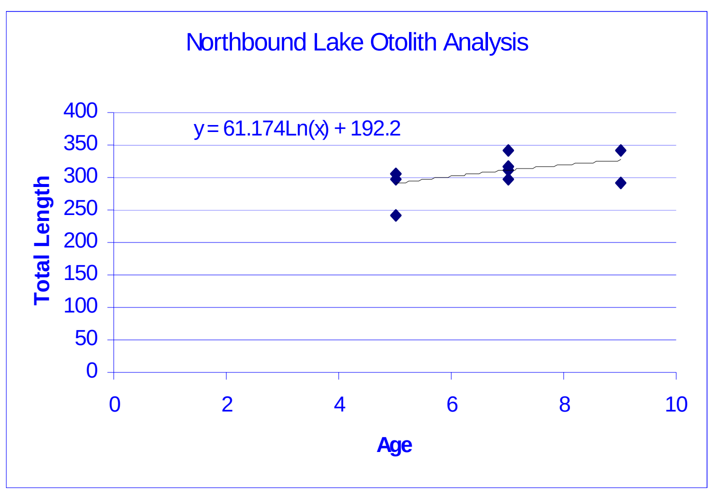
Survey Date: August 5, 1999
Stocking number 06-123
Sample Crew Leader: Jim Fredericks

Northbound Lake is a 4.75 ha lake located in the Mallard Larkins Wilderness Area at the headwaters of Northbound Creek, a tributary to Sawtooth Creek. The lake is located on the Mallard Peak quadrangle. Northbound is a moderately deep lake with a maximum depth of around 13 m and an average depth of 7-8 m. The lake appears to get an intermediate amount of use based on the number of campsites (4-5) and the lack of firewood. Northbound Lake is centrally located and can be accessed from any of the major trailheads, but requires a 8-10 km hike from each. We saw a fair amount of evidence of angling activity.



There seemed to be a moderate abundance of cutthroat trout based on rising fish and gill net catch. We collected 12 fish in a single, overnight gill net ranging in size from 240 to 340 mm in length and 130 to 400 g in weight. Mean condition factor was 1.02, indicating average condition. Based on otolith analysis, growth was good with fish generally achieving 300 mm by age-6. As with other lakes in the Mallard Larkins area, we saw evidence of exceptional longevity with cutthroat trout living at least nine years. We saw 10-12 fish spawning in the inlet stream during the survey. There was an abundance of adequate spawning habitat, although the likelihood of egg survival and fry emergence from fish spawning in August seems low.

Angling during the survey was not highly productive, despite an abundance of rising and feeding fish. Fish were particularly selective and were feeding on a large hatch of mayflies. In addition to the mayflies, we saw abundant dipterans and caddis flies. Shoreline fishing access is fair, but mainly limited to spin-fishing because of the heavy timber and brush.



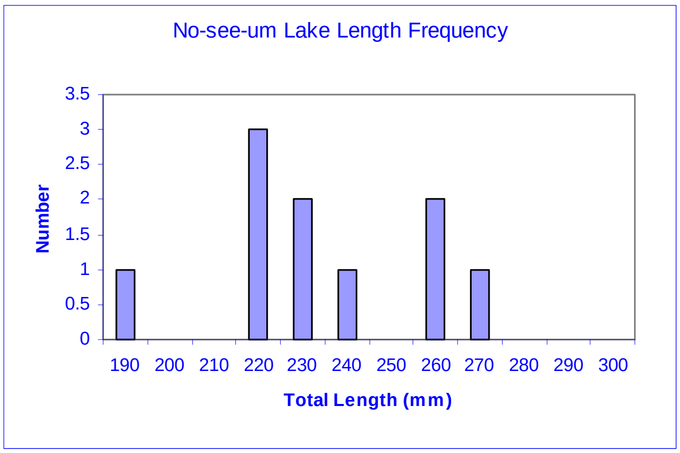
Northbound Lake has historically been stocked on alternate years with around 3,000 cutthroat trout fry (920/ha). Based on new stocking guidelines to optimize stocking densities based on elevation and productivity, we recommend an increase in stocking to 3,600 cutthroat trout fry (750/ha) on alternate years.

Appendix C. Continued.

No-see-um Lake

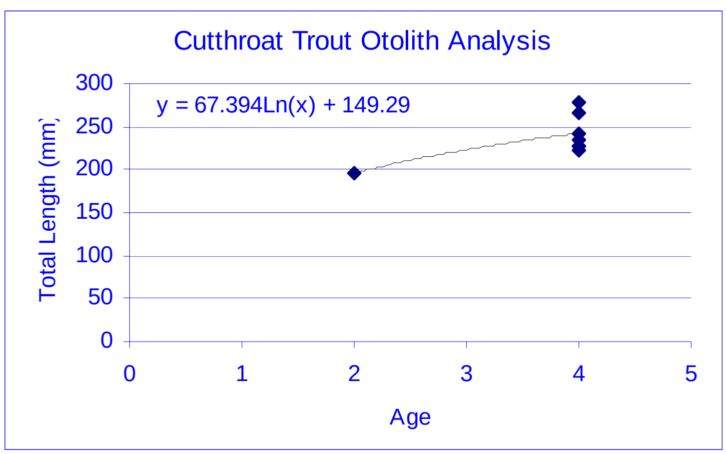
Survey Date: August 27, 1999
Stocking number 06-130
Sample Crew Leader: Jim Fredericks

No-see-um Lake is a 1.9 ha cirque lake located at headwaters of Butte Creek, a tributary to the Little North Fork of the Clearwater River. The lake can be found on the Butte Creek quadrangle. The lake is easily accessed by an approximately 1.6 km well-maintained trail, although the remote location and the driving time to the trailhead probably precludes the lake from getting more use than it does. There is a single campsite that appears to get a moderate amount of use. There was evidence of 4-wheeler ATV traffic to the lake in the past. The trail continues past No-see-um Lake another 2-3 km to Steamboat Lake.



Fish abundance was moderate based on observation of cruising and rising fish and based on our catch rates. We only caught two fish in an overnight gill net set, but this may have been a function of net placement or the bright moon. We caught an average of 6-7 fish/h by angling, ranging from 190 to 270 mm. Most were 220-230 mm (see figure at left). Fish ranged in weight from 89 to 200 g. Mean condition factor was 0.90, indicating below average condition. Growth was fair with cutthroat trout generally achieving 250 mm between age-4 and age-5 (see figure below).

We saw numerous dragonflies and damselflies, mosquitoes, and caddis flies. Columbia spotted-frogs were abundant in the outlet and around the lake itself. There was a fair amount of littoral habitat (floating woody debris, some emergent vegetation, overhanging brush) around the lake. Shoreline fishing access if fair. There is a partial trail around the lake, although the southwestern side is too steep and brushy to access. The entire north and eastern side of the lake can be fished with spin fishing equipment, although flyfishing would be difficult without the use of a float tube.



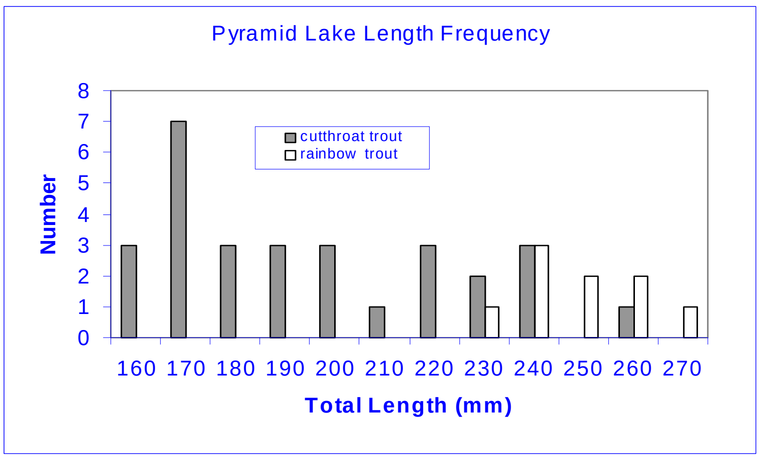
No-see-um Lake has generally been stocked with 1,000 cutthroat trout fry on an alternate year basis (525 fish/ha). Based on modified stocking guidelines, we recommend increasing the stocking rate to 1,400 fry on alternate years, for a density of 750 fry/ha.

Appendix C. Continued.

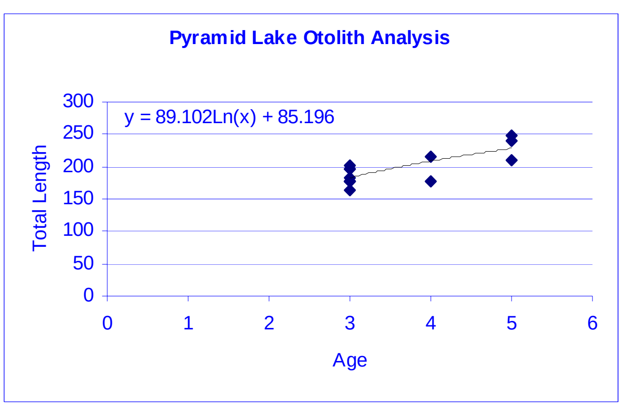
Pyramid Lake

Survey Date: July 20, 1999
Stocking number 01-125
Sample Crew Leader: Jim Fredericks

Pyramid Lake is an approximately 3.2 ha lake located at the headwaters of Trout Creek in the Kootenai River drainage of the Selkirk Mountains, and can be found on the Pyramid Lake quadrangle. The lake is situated in a northeast facing cirque. Pyramid Lake is relatively shallow, with a maximum depth of around 4 m. The lake is easily accessed by an approximately 2 km hike over a well-maintained trail. The lake is fairly heavily used. There are three to four good campsites and a complete trail around the lake. Despite the high use, there was a low abundance of litter when we surveyed the lake. Pyramid Lake is somewhat hourglass shaped, with a narrow section joining two "basins". The eastern basin of the lake is shallow, with an average depth of around 2 m, and the western basin is deeper with an average depth of around 3 m. The lake is not particularly productive based on the lack of aquatic vegetation, clarity of the water, and the low conductivity.



We collected and observed numerous fish in all areas of the lake. We caught a total of 29 cutthroat trout and nine rainbow trout in gill nets and by angling. Cutthroat trout averaged around 202 mm, and rainbows averaged 254 mm (see figure). Cutthroat trout had a mean condition factor of 1.07, whereas rainbow trout had a mean condition factor of only 0.86. Cutthroat trout growth was fairly slow, with fish not achieving 250 mm until for at least five years (see figure). Based on stocking records, the rainbow trout were most likely stocked in 1993, which would make them six years old, and indicates growth between the two species is similar. We did not see a high abundance of aquatic insects. Stomach analysis indicated fish were feeding primarily on chironomid larvae during our survey.



Pyramid Lake has been stocked with 1,750 to 4,000 fry annually in recent years for an average density of around 850 fry/ha. This is likely too high to achieve optimum growth given the productive capacity of Pyramid Lake. Our recommendation is to reduce stocking to 1,600 cutthroat trout fry for a density of 500 fry/ha and stock only on alternate years.

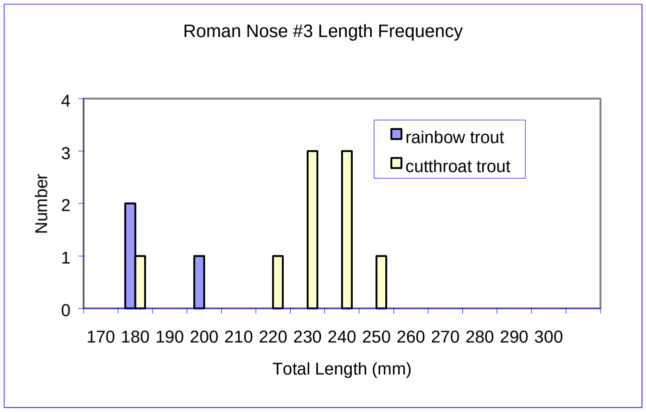
Appendix C. Continued.

Roman Nose Lake #3

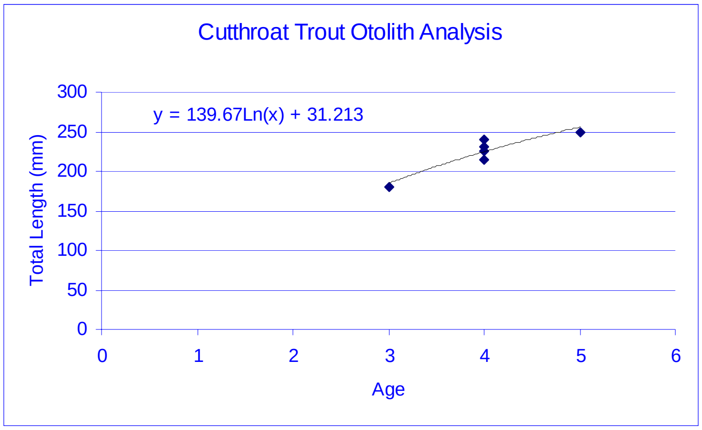
Survey Date: August 30-31, 1999
Stocking number 01-137
Sample Crew Leader: John Phillips

Roman Nose Lake #3 is an approximately 4.8 ha cirque lake at the headwaters of Caribou Creek in the Kootenai River drainage. The lake can be found on the Roman Nose quadrangle. As the name suggests, Roman Nose Lake #3 is one of three lakes in the immediate area. Roman Nose #3 is a "drive-to" lake with a well-maintained campground, three fishing docks and a complete trail around the lake. The lake receives a high level of angling and camping pressure. There is ample shoreline fishing opportunity around the lake.

Fish were moderately abundant during the 1999 survey. We collected nine cutthroat trout and three rainbow trout in a single overnight gill net set. Cutthroat trout were generally larger than the rainbow trout, ranging from 180 to 250 mm in length and from 60 to 137 g in weight. Rainbow trout ranged from 175 to 200 mm in length and from 56 to 90 g in weight (see figure). Growth of cutthroat trout was moderate with fish generally achieving 250 mm at about age-5. The rainbow trout collected in the nets were likely stocked in 1997, which would make them age-2 fish, and also indicates fair growth. The lack of many fish over 250 mm is likely a result of the level of use and exploitation rather than poor growth. Condition factor of cutthroat trout was .95, indicated nearly average condition of fish. The inlet to Roman Nose Lake #3 has a short reach of marginal spawning habitat.



We did not fish, nor see any fisherman during the survey. The lake is very oligotrophic and does not support significant macrophyte growth, amphibians, or a high abundance of aquatic invertebrates. No amphibians were observed, and insect abundance was low during the survey. Roman Nose Lake #3 has been typically stocked with around 3,000 cutthroat or rainbow trout fry each year. Based on the growth rates and unproductive nature of the water, we recommend reducing the stocking rate to 3,600 fry on alternate years only. Fish stocked should be westslope cutthroat trout when available, or sterile rainbow trout when cutthroat trout are unavailable.

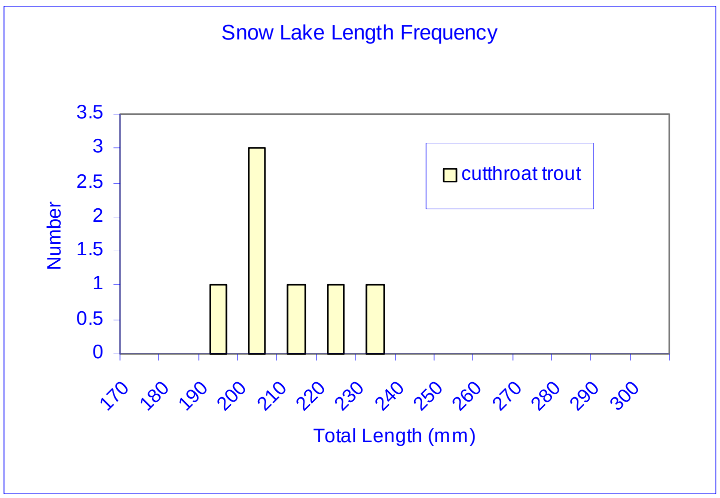


Appendix C. Continued.

Snow Lake

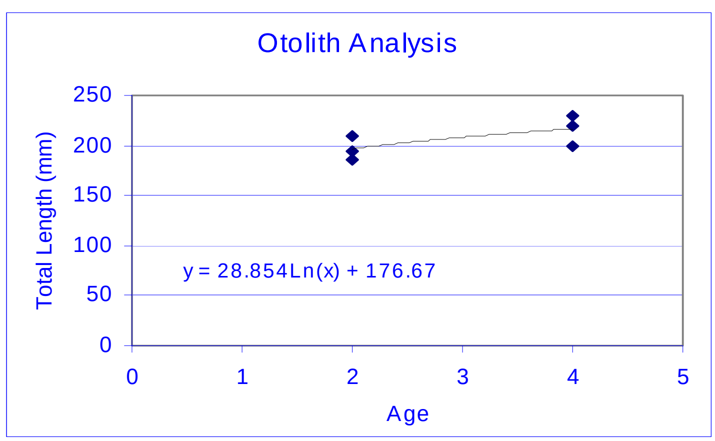
Survey Date: August 30-31, 1999
Stocking number 01-134
Sample Crew Leader: John Phillips

Snow Lake is a 3.6 ha lake at the headwaters of Snow Creek, a Deep Creek tributary in the Kootenai River drainage. Snow Lake is a northeast facing cirque lake at an elevation of 5,921 feet (1,805 m). The lake is located in Boundary County and can be found on the Roman Nose quadrangle. The hike to Snow Lake is around 7 km, but is relatively easy, with the first 4-5 km being along an old logging road, and the last 2-3 km being a well maintained trail. There is good access around the lake, with ample shoreline fishing potential. There are two fairly well-used campsites at the lake.



Snow Lake is a mostly oligotrophic unproductive lake with a specific conductance of 7.6 μmhos, a Secchi disk transparency of over 6 m, and no notable macrophyte growth. Snow Lake is relatively shallow with a maximum depth of 5.5 m and mean depth of around 4 m. No amphibians or insects were noted during the survey, and very few fish were seen rising. There were no anglers at the lake during the time of the survey. We suspect the general lack of activity was largely related to the cold weather, severe winds, and an early snowstorm (an accumulation of around four inches the morning of the survey).

We collected seven fish from Snow Lake during the survey--all were cutthroat trout caught by angling. Catch rates were fair with the seven fish being caught in about three hours of fishing effort. Fish ranged from 185 to 230 mm in length (see figure below) and from 60-113 g in weight. Condition factor was 0.8 to 1.04, indicating below average condition. Based on stocking records and otolith analysis, fish were either age-2 or age-4. Fish were generally achieving 200 mm at age-2, but were only around 225 mm at age-4 (see figure at right), indicating growth was moderate when compared with other lakes surveyed in the 1999 effort. Snow Lake has been stocked with around 2,500 cutthroat trout fry on alternate years. We recommend a slight increase to 2,700 fry on alternate years to conform to stocking table recommendations developed in 1999 based on elevation and acreage.

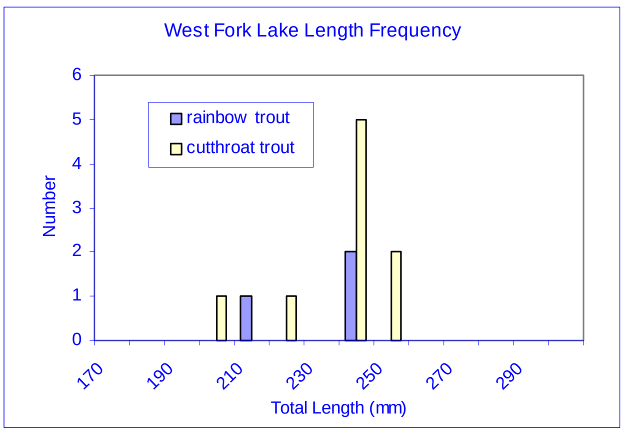


Appendix C. Continued.

West Fork Lake

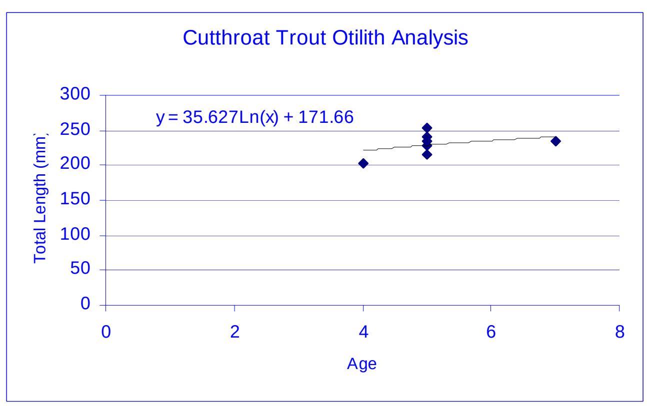
Survey Date: August 17, 1999
Stocking number 01-109
Sample Crew Leader: Jim Fredericks

West Fork Lake is a cirque lake located in the Smith Creek drainage, a tributary to the Kootenai River. West Fork Lake is very scenic, lying within a north facing alpine cirque and with West Fork Peak forming the head of the cirque. West Fork Lake lies at an elevation of 1,759 m (5,770 feet). The lake can be found on the Smith Peak quadrangle. The hike to the lake is moderately difficult. The distance is approximately 9 km along a well-maintained trail. There are about four campsites on the north side of the lake, and the area appears to receive a moderate amount of use. There is a partial trail around the lake and good shoreline fishing access.



West Fork Lake is moderately deep with an average depth of about 4.7 m (15 feet) and a maximum depth of 8.1 m (26 feet). The lake appears to be moderately productive. Although specific conductance was only 4.0 umhos and Secchi disc visibility was almost 8 m, there was an abundance of insects, primarily chironomids, trichoptera, and odonates. In addition, we saw dozens of Columbia spotted-frogs in both the larval and adult forms.

Fish were abundant during the survey of West Fork Lake. In about 2 h of fishing, two anglers caught 10 fish. In addition, we caught seven fish in a single overnight gill net set. We caught both westslope cutthroat and rainbow trout. Cutthroat trout ranged from 200 to 254 mm (8-10 inches) and averaged 237 mm (see figure below). Rainbow trout were not as abundant. They ranged from 216-247 mm and averaged 234 mm. Mean condition factor of both species was 1.00, indicating about average condition. Based on otolith analysis, cutthroat trout growth was fairly slow. Although fish collected ranged from four to seven years old, they were not generally achieving 250 mm, even by age-7. Although we did not collect otoliths from rainbow trout, they were last stocked in 1993. Spawning habitat in the outlet was quite limited, and most likely the rainbow trout we collected were age-6 fish, indicating that rainbow trout growth was similar to that observed in cutthroat trout.



West Fork Lake has generally been stocked on an annual basis with 3,000 fry. Based on the poor growth and the very high abundance of fish, we recommend a decrease in stocking to 3,300 fish on alternate years only.

1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: I-Surveys and Inventories

Subproject: I-A Panhandle Region

Job No.: b

Title: Lowland Lakes Investigations

Contract Period: July 1, 1999 to June 30, 2000

ABSTRACT

A midwater trawl was used to estimate the kokanee *Oncorhynchus nerka* population in Coeur d'Alene Lake in July. Trawl results indicated record low numbers of adult kokanee, with the total population of age-3 fish estimated at 55,100, or 6 fish/ha. We estimated 974,000 age-1 and 270,000 age-2 kokanee. The estimated population of age-0 kokanee was slightly over 4 million fish. The standing stock of kokanee was 6.54 kg/ha and is much improved over the 1998 estimate of 1.7 kg/ha. Kokanee fry collected in the trawl ranged from 30 to 70 mm TL, age-1 kokanee ranged from 80 to 200 mm, age-2 kokanee ranged from 180 to 270 mm, and age-3 kokanee ranged from 260 mm to 320 mm.

We counted 12 chinook salmon *O. tschawytscha* redds in the Coeur d'Alene River drainage and none in the St. Joe River. We estimated an additional five chinook salmon redds in Wolf Lodge Creek, based on observed redds and kelts. All redds were left undisturbed to provide natural production. We stocked 25,000 age-0 chinook salmon at the Mineral Ridge boat ramp. Harvested chinook salmon in 1999 were smaller than fish of the same age in past years. Age-3 chinook in August of 1999 averaged 750 mm (TL) and weighed 5.2 kg. By comparison, age-3 chinook in August of 1990 averaged 880 mm in length and weighed approximately 8.8 kg.

A midwater trawl was used to estimate the kokanee population in Spirit Lake in July. We estimated a total kokanee population of 381,800 fish. Age-3 kokanee ranged from 210 to 270 mm at the time of trawling, and the population was estimated at 34,800 fish, or 61 fish/ha. Age-2 kokanee ranged from 180 to 240 mm, and the population was estimated at 50,400. The age-1 kokanee ranged from 130 to 180 mm. The age-1 population at only 9,700 fish was the lowest estimate since trawling began in 1981.

Total angling effort on Spirit Lake from January through September 1999 was estimated at 82,000 h. Kokanee comprised the vast majority of fish creeled with an estimated total harvest of 161,553 fish. Nearly half of the total effort and 85% of the kokanee catch was during the ice fishery. Comparison with the 1992 creel survey indicates an increase in effort and harvest.

An additional 239 lake trout *Salvelinus namaycush* were tagged by the Priest Lake volunteer angler. Fish ranged from 280 to 560 mm (TL) with a mean size of 431 mm. A total of 20 previously tagged lake trout were reported in 1999. All had been tagged in Priest Lake between 1980 and 1999. Growth ranged from 0 to 3.5 cm/year with an average annual growth of 1.3 cm/year.

We conducted a standardized survey of Hauser Lake to assess changes in the fish community since the addition of tiger muskies *Esox lucius x E. masquinongy* and channel catfish *Ictalurus punctatus* beginning in 1990. As expected, channel catfish and tiger muskies comprised a much greater portion of the sample weight than in 1992. We saw no evidence that the yellow perch *Perca flavescens* and black crappie *Pomoxis nigromaculatus* populations have been negatively affected by channel catfish and/or tiger muskies. Both numerically and by weight, yellow perch comprised similar portions of the sample in 1999 as in 1992, and black crappie actually comprised a much greater portion of the sample in 1999 than in 1992. Rainbow trout *O. mykiss*, pumpkinseeds *Lepomis gibbosus*, green sunfish *L. cyanellus*, and brown bullheads *Ameiurus nebulosus* all comprised very similar portions of the 1992 and 1999 samples. The only species that showed a marked decline in relative abundance since 1992 were largemouth bass *Micropterus salmoides* and tench *Tinca tinca*.

We used gill nets to capture lake trout from Upper Priest Lake in June and July. We netted and removed a total of 321 lake trout in the five netting efforts. Mean catch rate throughout the 1999 effort was similar to the catch rate in the fall of 1998, and only slightly lower than the cumulative catch rate throughout the 1998 effort. We incidentally netted 15 bull trout *S. confluentus* and had no bull trout mortality. We saw no evidence of shifting size structure due to high exploitation in 1998, and the lake trout to bull trout ratio was not indicative of a substantial lake trout population reduction. The 1999 gillnetting results confirmed the importance of controlling lake trout immigration in the Thorofare if reduction efforts are to be effective.

We used gill nets and electrofishing equipment to evaluate the extent and timing of native and non-native species use of the Thorofare. We captured a total of 12 lake trout, 29 westslope cutthroat trout *O. clarki lewisi*, and one bull trout. Other species captured included northern pikeminnow *Ptychocheilus oregonensis*, mountain whitefish *Prosopium williamsoni,* tench, largescale sucker *Catostomus macrocheilus*, peamouth *Mylocheilus caurinus*, and yellow perch. Ten of the 12 lake trout were caught during night sets in October when water temperature was around 8°C. Cutthroat CPUE was highest during dusk hours of the month of August. The single bull trout was caught during daylight hours of September when water temperature was 16° C.

We used backpack electrofishing equipment to conduct follow-up electrofishing surveys of Ruby and Rock creeks to assess effectiveness of 1998 brook trout *S. fontinalis* suppression efforts. In Rock Creek, brook trout comprised 23% of the total catch in 1999 compared with 38% in 1998, and westslope cutthroat trout comprised 75% of the catch in 1999 compared with 60% in 1998. In Ruby Creek, brook trout comprised 54% of the catch in 1999 compared with 81% of the catch in 1998, and cutthroat trout comprised 46% of the catch in 1999 compared with 19% in 1998. Despite the statistically significant improvements in the species compositions, the shift in relative abundance of brook trout and cutthroat trout will probably be short-lived and is not likely biologically significant.

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OBJECTIVES

1. Evaluate stock status of kokanee *Oncorhynchus nerka* in Coeur d'Alene Lake.

2. Evaluate chinook salmon *O. tschawytscha* stocking rates in Coeur d'Alene Lake.

3. Count chinook salmon redds in the Coeur d'Alene and St. Joe rivers and estimate production of wild chinook.

4. Evaluate stock status and harvest of kokanee in Spirit Lake.

5. Use tag-return information to estimate lake trout *Salvelinus namaycush* growth rates in Priest Lake.

6. Conduct a standard lake survey of Hauser Lake to evaluate the impact of tiger muskie *Esox lucius x E. masquinongy* and channel catfish *Ictalurus punctatus* stocking on the yellow perch *Perca flavescens* and black crappie *Pomoxis nigromaculatus* populations.

7. Compare gill net catch rates of lake trout in Priest Lake in June 1999 with catch rates from fall 1998 to provide additional information on the effectiveness of 1998 lake trout suppression efforts.

8. Use gill nets and electrofishing equipment to evaluate the extent and timing of native and non-native species use of the Thorofare between Priest and Upper Priest lakes.

9. Conduct a follow-up electrofishing survey of Ruby and Rock creeks, tributaries to the Upper Priest River, to assess relative abundance of species and provide additional information on the effectiveness of 1998 brook trout *Salvelinus fontinalis* suppression efforts.

METHODS

Fish Population Characteristics

Coeur d'Alene Lake

Kokanee Population Estimate--We used a midwater trawl, as described by Bowler et al. (1979), Rieman and Meyers (1990), and Rieman (1992), to estimate the kokanee population in Coeur d'Alene Lake. Twenty-two transects were trawled during the dark phase of the moon August 9-10, 1999. Trawl transects were selected using a stratified random sample design and were in identical locations (as near as possible) to those used in previous years (Figure 1). Kokanee were measured and weighed, and scale and otoliths were collected from representative length groups for age analysis.

We used an experimental sinking gill net to estimate mean length of male and female kokanee spawners. The net was set at depths of 3-5 m near Higgins Point for one hour on

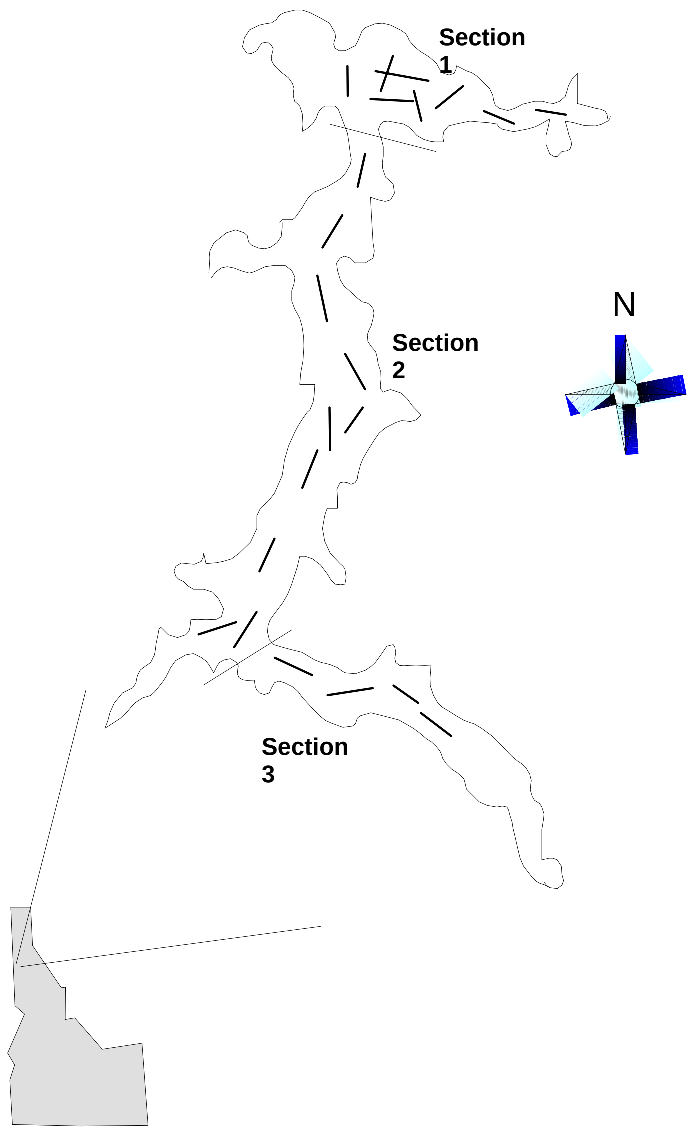

Figure 1. Location of the midwater trawling transects in three sections of Coeur d'Alene Lake, Idaho, used to estimate the kokanee population.

December 6, 1999. Potential egg deposition (PED) was estimated as the number of female kokanee spawners (half the mature population based on midwater trawling) multiplied by the average number of eggs produced per female. The average number of eggs produced per female kokanee was calculated using the following length to fecundity regression (Rieman 1992):

$$Y = 3.98x - 544$$

Where: x = mean length of female kokanee spawners (mm)
Y = mean number of eggs per female

Chinook Salmon Abundance--As in previous years, we utilized a combination of hatchery reared and naturally produced juvenile chinook salmon to propagate the chinook population in Coeur d'Alene Lake. We estimated the natural production using redd counts, an estimate of 4,000 eggs per redd, and a mean egg-to-smolt survival of 10%. Department personnel used a helicopter to conduct chinook redd surveys in the Coeur d'Alene River, North Fork Coeur d'Alene River, South Fork Coeur d'Alene River, Little North Fork Coeur d'Alene River and St. Joe River on October 7, 1999. We did not install a fish weir on Wolf Lodge Creek to collect eggs from migrating adult chinook salmon because of the low number of returning adult chinook. We conducted kelt and redd surveys to estimate natural reproduction in Wolf Lodge Creek.

We conducted creel surveys on the four chinook derbies held on Coeur d'Alene Lake in 1999. We estimated the total number of chinook caught, harvested, and released, and calculated catch rates of each derby. In addition, we collected length and weight information from fin-clipped chinook. Throughout the 1999 season we evaluated mean length-at-age of the three hatchery year classes represented.

Spirit Lake

We used a midwater trawl on the night of August 11, 1999 to estimate the kokanee population and relative year-class abundance in Spirit Lake. We trawled the same five transects that have been trawled in previous years (Figure 2). Kokanee lengths and weights were recorded, and scales and otoliths were collected from representative length groups for age analysis.

We conducted a creel survey from January through September to evaluate the kokanee harvest during the ice fishery, the spring fishery, and the summer fishery. Three weekdays and three weekend days were randomly selected each month for instantaneous counts and angler interviews.

Priest Lake

Lake trout were tagged as part of an ongoing effort to quantify angler exploitation and help define the population dynamics of lake trout in Priest Lake. All fish were caught and tagged by Randy Phelps, a volunteer angler. Spaghetti tags were placed in the dorsal musculature

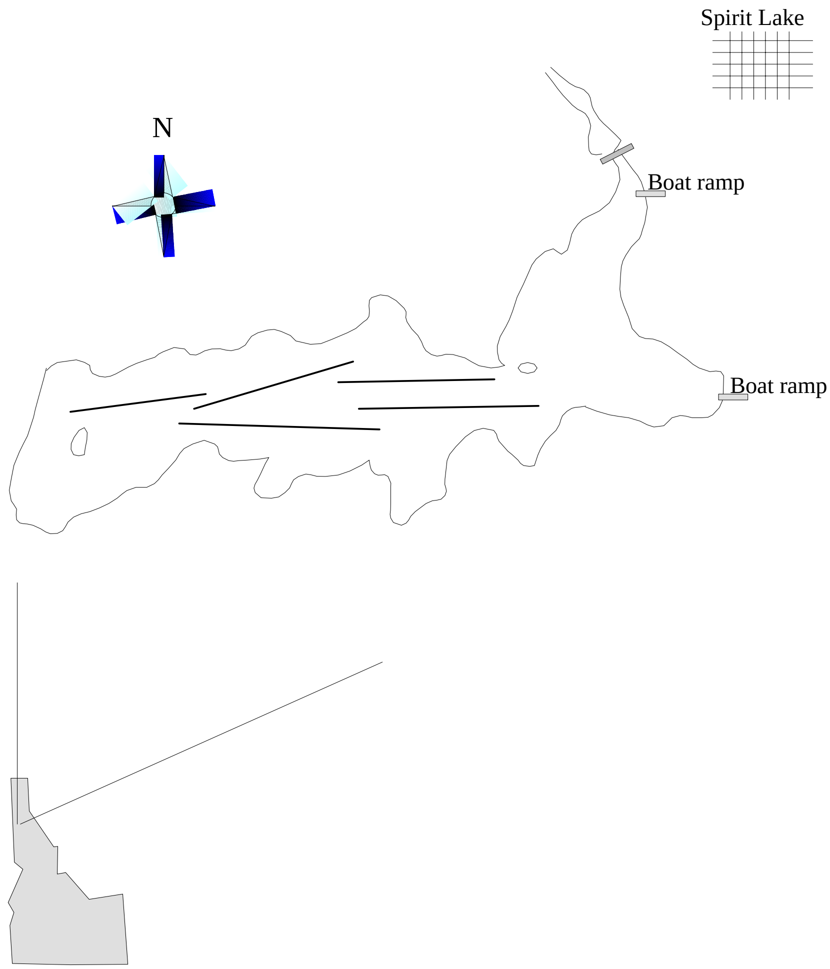

Figure 2. Location of the five midwater trawl transects used to estimate the kokanee population in Spirit Lake, Idaho.

beneath the dorsal fin. Catch location, date, fish length and weight, and any comments regarding the health or release of the fish were recorded at the time of tagging along with the tag number. Fish were released into the same site from which they were captured.

In addition, we continued to collect information from lake trout with tags from previous years as reported by anglers in 1999. We summarized total and annual growth and distance from original capture.

Hauser Lake

We conducted a standard lowland lake survey on Hauser Lake using procedures outlined in the Standard Lowland Lakes Survey Manual. We used three trap nets, three floating and three sinking gill nets, and two hours of electrofishing effort. We then standardized our catch to a single unit of effort (one trap net, one pair of gill nets, and one hour of electrofishing time). Netting and electrofishing were conducted on the night of June 28. Limnology and zooplankton collection was conducted on August 25.

Upper Priest Drainage Exotic Fish Control Evaluation

Upper Priest Lake Gillnetting

We used gill nets from June 3 to July 8, 1999 to capture lake trout from Upper Priest Lake. As in 1998, we used experimental, monofilament, sinking gill nets which we pulled every 45-50 minutes. We used 91.4 x 2.4 m experimental nets with three panels of 2.5, 3.8, and 5.1 cm mesh and fished two to three nets per set. We standardized catch to a unit of sampling effort (fish/h/100 m^2 of gill net) to allow comparison with 1998 netting efforts. Gill nets were set throughout the entire lake and were moved based on catch rates at a particular site and the discretion of the netting crew. A concerted effort was made to avoid incidental bull trout *S. confluentus* captures. Incidentally captured bull trout were implanted with visual implant (VI) tags and released. Nets were set during daylight hours only.

Thorofare Evaluation

Gillnetting--In the summer and fall of 1999 a two-person crew used gill nets to capture fish moving through the Thorofare between Priest and Upper Priest lakes. We used experimental, monofilament, sinking gill nets (45.7 x 1.8 m with six panels ranging from 1.8 to 6.4 cm bar measure mesh) which were checked hourly. We set two to three nets perpendicular to the current at a location midpoint of the Thorofare. Since boat traffic usually is heavy between 10:00 and 18:00, nets were not set during that time period July through September. In June and October, reduced boat traffic allowed for setting gill nets between 10:00 and 18:00. In June, nets were set only in daylight hours.

With each set we recorded the set and pull times and the surface water temperature. Depth of the Thorofare was measured daily and the Secchi depth of both Upper Priest Lake and Priest Lake was determined weekly. All captured fish were weighed and measured. Fish that survived the collection procedure were returned to the Thorofare. For genetic sampling purposes, a 1 cm^2 piece of the anal fin was removed from cutthroat trout *O. clarki lewisi*.

We calculated catch per unit effort (CPUE) for cutthroat trout for each month and the diel periods dawn, day, dusk, and night. CPUE was calculated as fish caught/h of fishing effort, where one hour of sampling effort equaled one gill net fished for one hour. Dawn and dusk were identified as the 2.5 h period before and after sunrise and sunset, respectively.

<u>Electrofishing</u>--On August 19, 1999 a two-person crew electrofished the Thorofare using a Smith-Root electrofishing boat. Since the stream channel varies in depth we made two passes along the shorelines of the Thorofare, concentrating the effort to the portions of the channel most likely to hold fish. We recorded the start and end time of each pass and the surface water temperature. All captured fish were identified to species, weighed and measured.

Tributary Electrofishing

We used backpack electrofishing equipment on July 29 to sample Ruby Creek and Rock Creek, two tributaries of the Upper Priest River identified as having sympatric bull trout and brook trout populations. In 1998 we used multiple pass depletion to remove as many brook trout as possible. As in 1998, our 1999 electrofishing efforts were conducted from the tributary mouths upstream to where gradient increased and brook trout were no longer collected. Rock Creek was electrofished from the mouth upstream about 2 km, and Ruby Creek was electrofished from the mouth upstream about 3 km.

RESULTS

<u>Fish Population Characteristics</u>

Coeur d'Alene Lake

<u>Kokanee Abundance--</u>Trawl results indicated record low numbers of adult kokanee with the total population of age-3 fish estimated at 55,100, or 6 fish/ha (Table 1). This year-class (1996 age-2 kokanee) was also the lowest recorded last year, and the low numbers of age-3 fish in 1999 was expected. We estimated 974,000 age-1 and 270,000 age-2 kokanee. Both of these year classes were below the 1979-1998 mean but were substantially higher than the 1998 estimates (Figure 3). The estimated population of age-0 kokanee was higher than the previous mean at slightly over 4 million fish. The standing stock of kokanee in Coeur d'Alene Lake was 6.54 kg/ha. This is much improved over the 1998 estimate of 1.7 kg/ha. Consistent with previous years, highest age-0 kokanee densities were in the northern section of the lake (Table 2). Based on the 1998 PED estimate and the 1999 age-0 estimate, egg to fry survival was 15.7%, which is much higher than previous years (Table 3).

Table 1. Estimated abundance of kokanee made by midwater trawl in Coeur d=Alene Lake, Idaho, from 1979-1999. To follow a particular year class of kokanee, read up one row and right one column.

Sampling	Age class					
year	Age 0+	Age 1+	Age 2+	Age 3/4+	Total	Age 3+/ha
1999	4,091,500	973,700	269,800	55,100	5,390,100	6
1998	3,625,000	355,000	87,000	78,000	4,145,000	8
1997	3,001,100	342,500	97,000	242,300	3,682,000	25
1996	4,019,563	30,278	342,369	1,414,144	5,806,354	147
1995	2,000,000	620,000	2,900,000	2,850,000	8,370,000	296
1994	5,950,000	5,400,000	4,900,000	500,000	12,600,000	52
1993	5,570,000	5,230,000	1,420,000	480,000	12,700,000	50
1992	3,020,000	810,000	510,000	980,000	5,320,000	102
1991	4,860,000	540,000	1,820,000	1,280,000	8,500,000	133
1990	3,000,000	590,000	2,480,000	1,320,000	7,390,000	137
1989	3,040,000	750,000	3,950,000	940,000	8,680,000	98
1988	3,420,000	3,060,000	2,810,000	610,000	10,900,000	63
1987	6,880,000	2,380,000	2,920,000	890,000	13,070,000	93
1986	2,170,000	2,590,000	1,830,000	720,000	7,310,000	75
1985	4,130,000	860,000	1,860,000	2,530,000	9,370,000	263
1984	700,000	1,170,000	1,890,000	800,000	4,560,000	83
1983	1,510,000	1,910,000	2,250,000	810,000	6,480,000	84
1982	4,530,000	2,360,000	1,380,000	930,000	9,200,000	97
1981	2,430,000	1,750,000	1,710,000	1,060,000	6,940,000	110
1980	1,860,000	1,680,000	1,950,000	1,060,000	6,500,000	110
1979	1,500,000	2,290,000	1,790,000	450,000	6,040,000	46
Previous 0	3,361,000	1,736,000	1,945,000	1,032,000	7,878,000	104

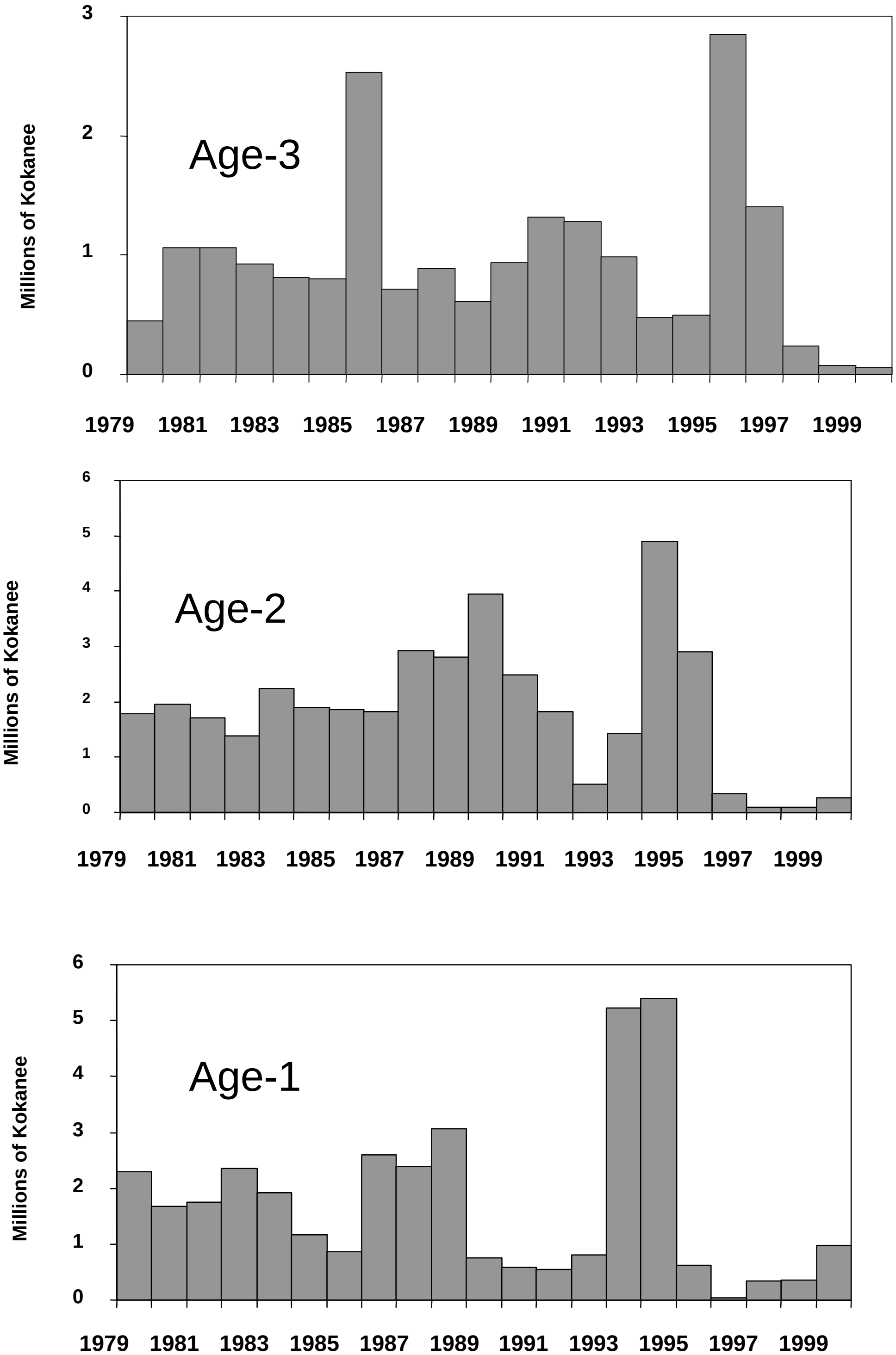

Figure 3. Bar graphs of the kokanee population by age-class as estimated by midwater trawl in Coeur d'Alene Lake, Idaho, from 1979 to 1999.

Table 2. Kokanee density (fish/ha) estimates for each age class in each section of Coeur d'Alene Lake, Idaho, August 9-10, 1999.

Section	Age 0	Age 1	Age 2	Age 3	Total
1	3,620,412	244,401	38,308	4,163	3,907,284
2	458,344	587,412	228,112	50,926	1,324,794
3	12,734	141,881	3,396	0	158,011
Whole lake (∀90% CI)	4,091,490 (∀46%)	973,694 (∀45%)	269,816 (∀47%)	55,088 (∀50%)	5,390,087

Table 3. Estimates of female kokanee spawning escapement, potential egg deposition, fall abundance of kokanee fry, and their subsequent survival rates in Coeur d'Alene Lake, Idaho, 1979-1999.

Year	Estimated female escapement	Estimated potential number of eggs (x10^6)	Fry estimate the following year (x10^6)	Percent egg to fry survival
1999	28,000	19		
1998	39,000	26	4.09	15.73
1997	90,900	54	3.60	6.67
1996	707,000	358	3.00	0.84
1995	1,425,000	446	4.02	0.90
1994	250,000	64	2.00	0.31
1993	240,000	92	5.95	6.46
1992	488,438	198	5.57	2.81
1991	631,500	167	3.03	1.81
1990	657,777	204	4.86	1.96
1989	516,845	155	3.00	1.94
1988	362,000	119	3.04	2.55
1987	377,746	126	3.42	2.71
1986	368,633	103	6.89	6.68
1985	530,631	167	2.17	1.29
1984	316,829	106	4.13	3.90
1983	441,376	99	0.70	0.71
1982	358,200	120	1.51	1.25
1981	550,000	184	4.54	2.46
1980	501,492	168	2.43	1.45
1979	256,716	86	1.86	2.20

Kokanee fry collected in the trawl ranged from 30 to 70 mm TL. Age-1 kokanee ranged from 80 to 200 mm, with a modal length of around 135 mm. Age-2 fish ranged from 180 to 270 mm, with a modal length of around 200 mm. Size of the age-3 kokanee at the time of trawling ranged from 260 mm to 320 mm, with a modal length of 275 mm (Figure 4). Typical of kokanee in Coeur d'Alene Lake, maturity was primarily at age-3. Three of 35 age-2 kokanee examined were mature males, and no mature age-2 were found. All of the age-3 kokanee captured were mature.

In a half-hour gill net set, we collected 108 kokanee spawners near Higgins Point, Wolf Lodge Bay. Males far outnumbered females, with only around 7% of the sample being females. Female mean and modal lengths were 305 mm and 300 mm (TL), respectively (n=7, SD=12.7). Male mean and modal lengths were both 330 mm (n=100, SD=14.4). Mean length of spawners was comparable to 1998. Spawner length during these two years is the largest it has been since 1960 (Figure 5). Mean fecundity was estimated at 670 eggs per female based on a mean female spawner length of 305 mm, and potential egg deposition was approximately 18.5 million eggs (Table 3). This is the lowest PED estimate to date and is well below the average for the past 18 years (142 million).

Chinook Salmon Abundance--We counted 12 chinook salmon redds in the Coeur d'Alene River drainage and none in the St. Joe River. We estimated an additional five chinook redds in Wolf Lodge Creek, based on observed redds and kelts. We, therefore, estimated the total number of redds in the drainage at 15 (Table 4). All redds were left undisturbed to provide natural production. Conditions for counting were favorable (clear skies and clear water), and we were easily able to see most redds.

We stocked 25,000 age-0 chinook salmon at the Mineral Ridge boat ramp in Wolf Lodge Bay on June 12, 1999 (Table 5). Chinook eggs were collected at Big Springs Hatchery in Oregon and were reared in Cabinet Gorge Hatchery. All were marked with a right ventral fin clip with the assistance of volunteers from the Lake Coeur d'Alene Anglers Association.

Catch rates of chinook salmon during the four derbies on Coeur d'Alene Lake ranged from 11 to 65 hours per fish (Table 6). These catch rates are somewhat misleading in that they reflect a large percentage of immature fish (400 to 600 mm). Size-at-age of chinook in 1999 was much less than in 1990 (Maiolie and Davis 1995). Age-3 chinook in August 1999 averaged 750 mm (TL) and weighed 5.2 kg. By comparison, age-3 chinook in August 1990 averaged 880 mm in length and weighed approximately 8.8 kg. Age-2 and age-4 chinook were likewise much smaller in 1999 than in 1990 (Figure 6).

Chinook Kokanee Relationship---We added the 1999 data to the regression depicting the relationship between the number of chinook stocked in Coeur d'Alene Lake and the estimates of kokanee population in following years (Figure 7). The abundance of age-2 kokanee was used as the dependent variable plotted against the number of age-0 chinook stocked and produced naturally two years earlier (Figure 8). The additional data point supported previous year's results, indicating around one third of the variability in kokanee numbers is determined by chinook abundance. The linear regression lines suggest that the optimal age-2 kokanee density (60 to 125 fish/ha) is associated with chinook stocking levels (including natural production) of 60,000 to 80,000 fish.

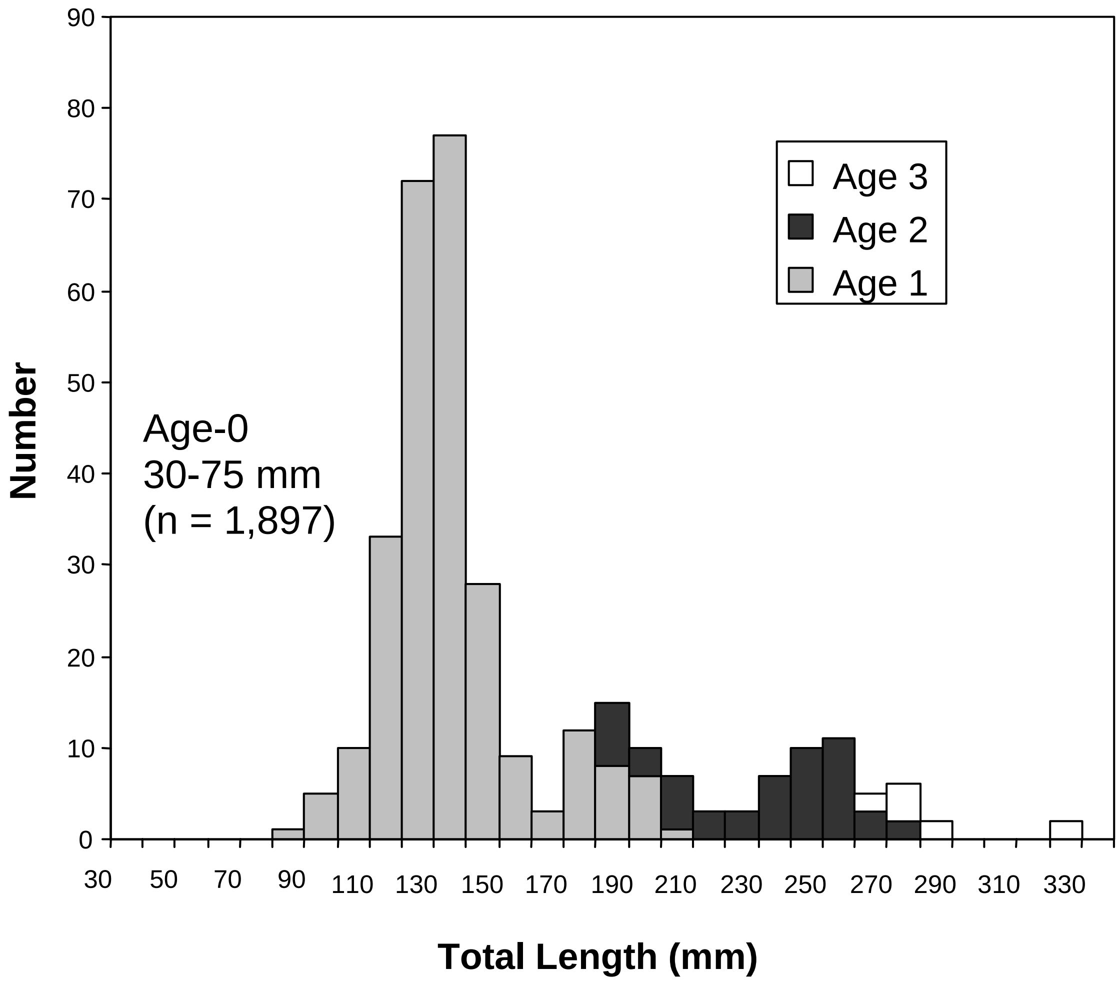

Figure 4. Length frequency and age of kokanee collected by midwater trawling in Coeur d'Alene Lake, Idaho, in August, 1999.

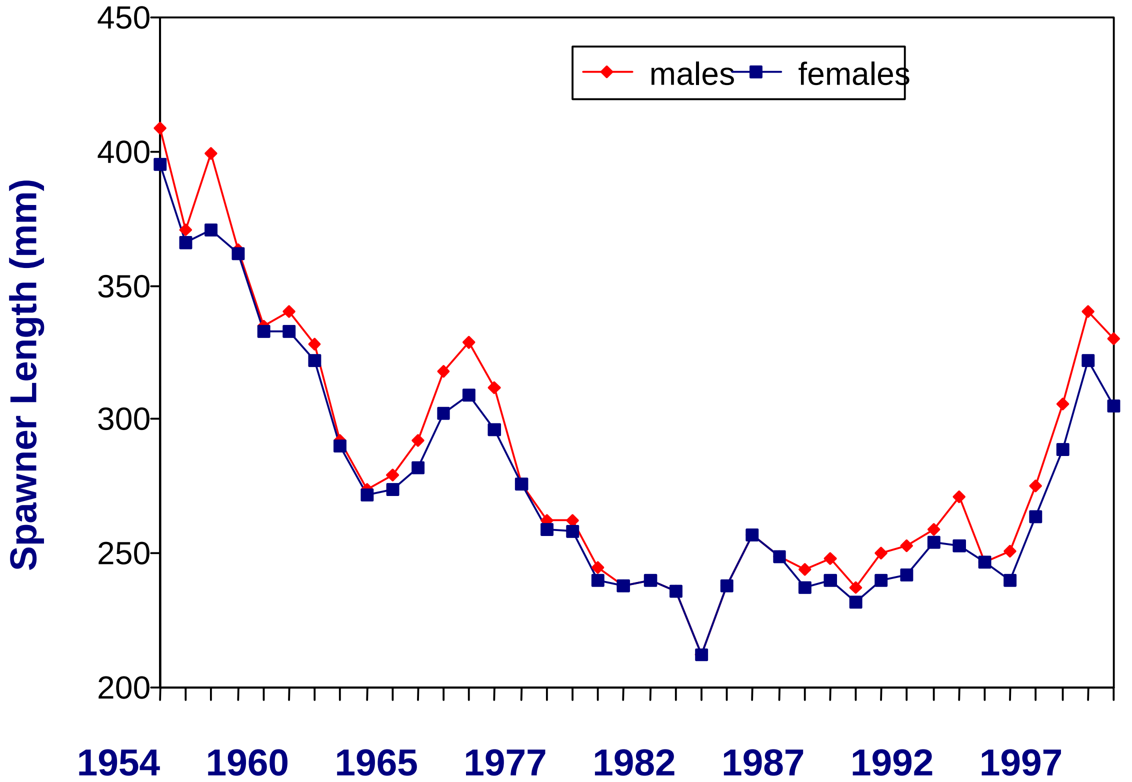

Figure 5. Mean total length of male and female kokanee spawners in Coeur d'Alene Lake, Idaho from 1954 to 1999. Years when mean lengths were identical between sexes are a result of averaging male and female lengths.

Table 4. Chinook salmon redd counts in the Coeur d=Alene River drainage, St. Joe River, Lake Creek, Fighting Creek, and Wolf Lodge Creek, 1990-1999.

Location	Survey date									
	11/1/90	10/31/91	10/20/92	10/18/93	10/10/94	10/04/95	10/7/96	10/7/97	10/7/98	10/7/99
Coeur d'Alene River										
Cataldo Mission to S.F. Cd'A River	41	11	29	80	82	45	54	18	11	7
S.F. Cd'A River to L.N.F. Cd'A River	10	0	5	11	14	14	13	5	3	5
L.N.F. Cd'A River to Steamboat Creek	--	2	3	6	1	1	13	6	1	0
Steamboat Creek to steel bridge	--	--	1	0	0	2	0	3	0	0
Steel bridge to Beaver Creek	--	--	--	--	0	0	0	1	0	0
S. F. Cd=A River	--	--	--	--	13	--	4	0	0	0
L.N.F. Cd'A River	--	--	--	--	0	2	0	0	0	0
Coeur d'Alene River Subtotal	51	13	38	97	110	64	84	33	15	12
St. Joe River										
St. Joe City to Calder	4	0	18	20	6	1	59	20	3	0
Calder to Huckleberry C.G.	3	1	1	4	0	0	5	2	1	0
Huckleberry C.G. to Marble Creek	3	0	2	0	1	0	7	2	0	0
Marble Creek to Avery	0	0	0	0	1	0	0	0	2	0
St. Joe River Subtotal	10	1	21	24	8	1	71	24	6	0
Coeur d'Alene Lake Tributaries										
Lake Creek	5	--	3	--	--	--	--	--	--	--
Fighting Creek	0	--	1	--	--	--	--	--	--	--
Wolf Lodge Creek									4	5
TOTAL	66	14	63	121	118	65	155	57	25	17

Table 5. Number of chinook salmon stocked and estimated number of naturally produced chinook salmon entering Coeur d'Alene Lake, Idaho, 1982-1999.

	Hatchery produced			Naturally produced		
Year	Number	Origin	Fin clip	Redds	Estimated smolts	Total
1982	34,4000	Bonneville	--	--	--	34,400
1983	60,100	Bonneville	--	--	--	60,100
1984	10,500	Lake Michigan	--	--	--	10,500
1985	18,500	Lake Michigan	Left ventral	--	--	18,500
1986	29,500	Lake Michigan	Right ventral	--	--	29,500
1987	59,400	Lake Michigan	Adipose	--	--	59,400
1988	44,600	Coeur d=Alene	Left ventral	--	--	44,600
1989	35,400	Coeur d=Alene	Right ventral	--	--	35,400
1990	36,350	Coeur d=Alene	Adipose	52	23,400	59,100
1991	42,650	Coeur d=Alene	Left ventral	70	31,500	73,100
1992	10,000	Coeur d=Alene	Right ventral	14	6,300	16,300
1993	0	Coeur d=Alene	--	63	28,350	28,350
1994	17,269	Coeur d=Alene	Adipose	100	40,000	57,269
1995	30,200	Coeur d=Alene	Left ventral	100	40,000	70,200
1996	39,700	Coeur d=Alene	Right ventral	65	26,000	65,700
1997	12,100	Coeur d=Alene	Adipose	84	33,600	45,700
1998	55,200	Priest Rapids	Left ventral	37	14,800	70,000
1999	25,000	Big Springs	Right ventral	25	10,000	35,000

Table 6. Summary of effort, harvest, and catch rates during the 1999 chinook salmon derbies, Coeur d=Alene Lake, Idaho.

	Total	Estimated number of chinook			Catch rate
Derby	rod hours[a]	Caught	Harvested	Released	(hrs/fish)
April (Spring Derby)	4,620	210	154	56	22
June (LCAA Members)	3,675	56	--	--	65
August (Big One)	21,000	393	--	--	53
December (Ice-breaker)	1,500	144	30	114	11
Total	30,795	803	--	--	38

[a] Catch rates and total hours reflect the "two-pole" stamp rule, implemented in 1999, which increased the rods-hours per person and likely decreased hourly catch rate.

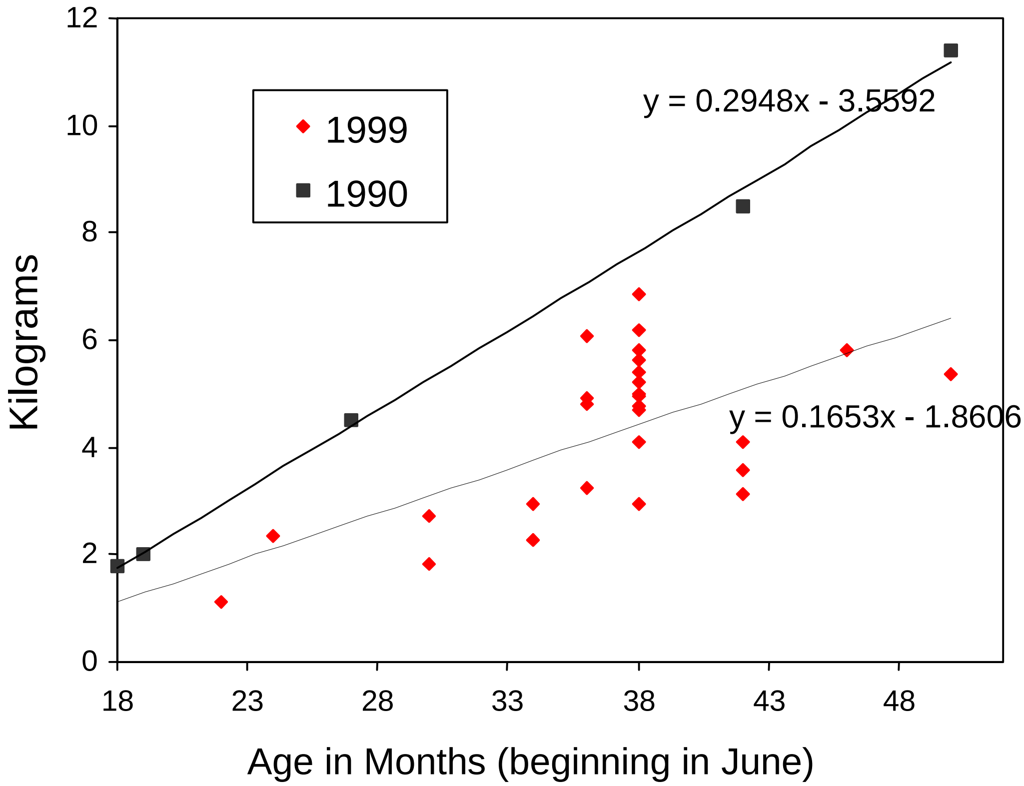

Figure 6. Weight-at-age relationships of chinook salmon from Coeur d'Alene Lake, Idaho, in 1999 and 1990. Points used in the 1990 regression are the means of multiple fish.

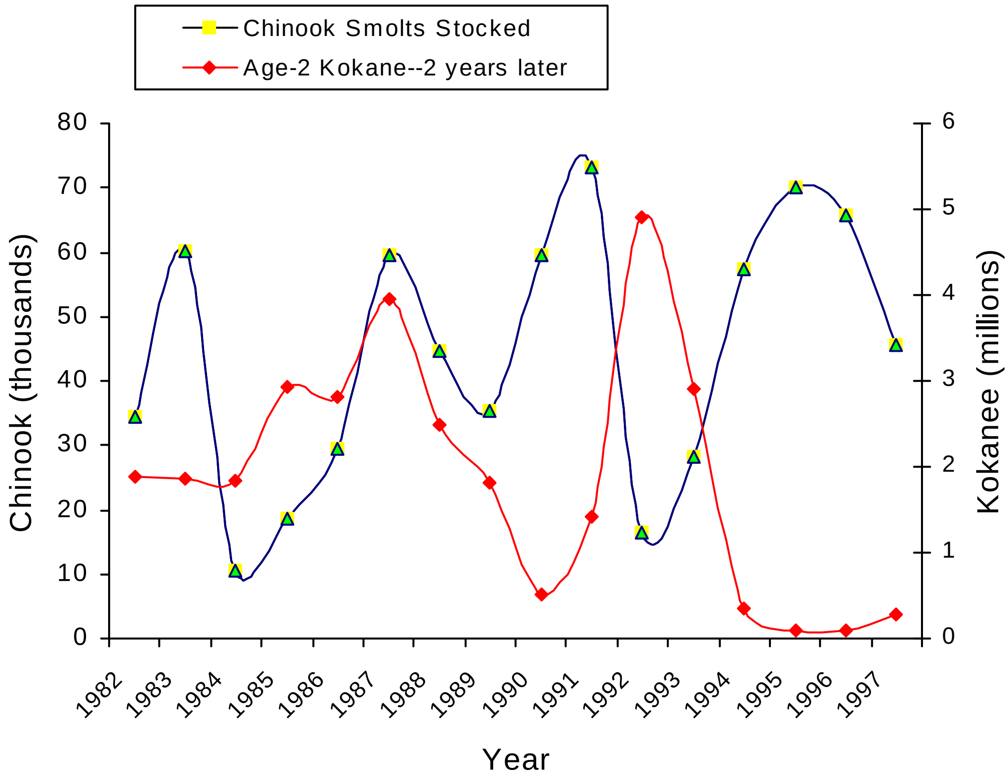

Figure 7. Estimated number of hatchery and naturally produced chinook smolts entering Coeur d'Alene Lake, Idaho, since 1982, and the abundance of age-2 kokanee two years later, as estimated by midwater trawling.

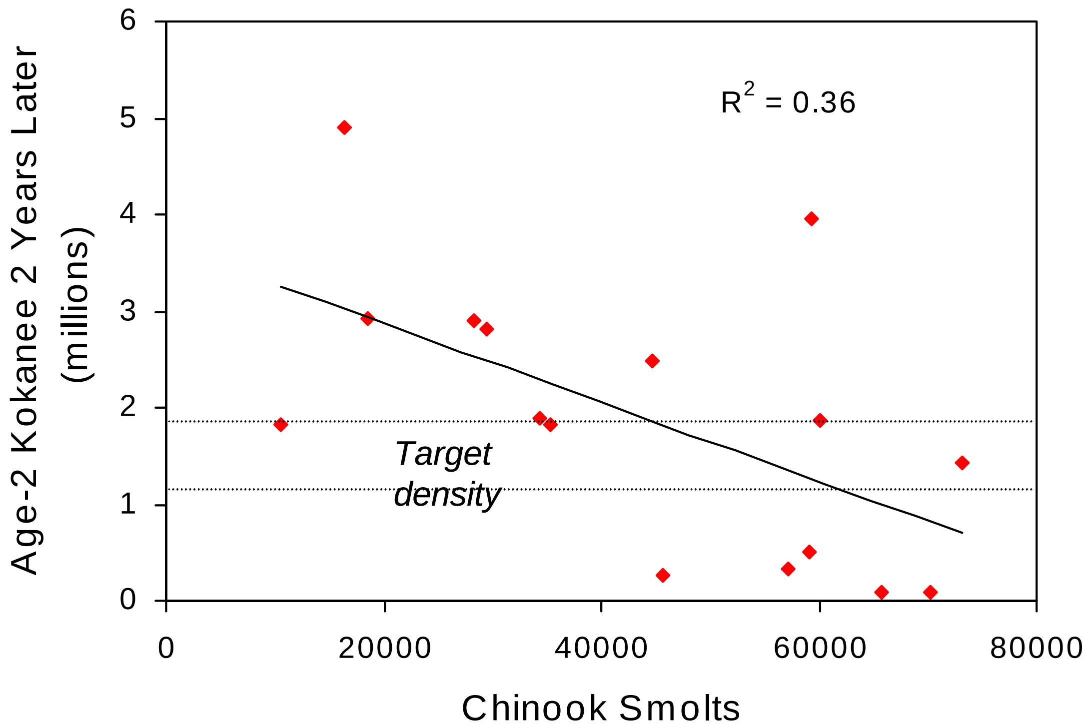

Figure 8. Linear regression model of the number of chinook smolts entering Coeur d'Alene Lake, Idaho, and the abundance of age-2 kokanee two years later.

Spirit Lake

Kokanee Abundance--We estimated a total kokanee population in Spirit Lake of 381,800 fish, a density of 666 fish/ha (Table 7). Abundance of age-3 kokanee was estimated at 34,800 fish, or 61 fish/ha. Age-2 kokanee were estimated at 50,400. The age-1 kokanee population was the lowest estimate since trawling began in 1981 at only 9,700 fish. Age-0 kokanee were estimated at 286,900. We estimated the total biomass of kokanee in Spirit Lake at 16.8 kg/ha.

Age-3 kokanee ranged from 210 to 270 mm at the time of trawling. Age-2 kokanee were bimodally distributed in length and ranged from 180 to 240 mm, overlapping with age-1 kokanee, which ranged from 130 to 180 mm (Figure 9). Age-0 kokanee ranged from 30 to 60 mm.

Creel Survey--Total angling effort on Spirit Lake from January through September 1999 was estimated at 82,000 h (∀23% at 95% CI; Table 8). A total of 171,732 (∀33%) fish were harvested. Kokanee comprised the vast majority of fish creeled with an estimated total harvest of 161,553 fish (∀33%). Nearly half of the total effort (38,740 h) was during the January-March ice-fishery, by anglers targeting kokanee. During this period, anglers harvested approximately 138,140 kokanee, or 85% of the total. Mean catch rate during the 1999 survey was 0.5 fish/h, however catch rates were much higher in the winter months than during the spring and summer. Catch rates ranged from 4.4 kokanee/h in February to less than one fish/h from April through September. Based on angler interviews during the creel survey, most angling effort (90%) was by residents. Completed trip surveys in January through March indicated most anglers (69%) caught more than six fish. Of 85 completed trips, 42 anglers (about 50%) had caught limits of kokanee (25 fish), and mean harvest was 17 fish. Only around 15% of anglers caught no fish.

Comparison with the 1992 creel survey indicates an increase in effort and harvest (Table 9). The value of the comparison is somewhat limited because the 1992 creel survey was run from April through September and did not include the January through March ice fishery. However, because of mild conditions and lack of ice, the 1992 ice-fishery was minimal in comparison with 1999.

Priest Lake

An additional 239 lake trout were tagged by the Priest Lake volunteer angler. Fish ranged from 280 to 560 mm (TL), with a mean size of 431 mm. Most of these fish (93%) were tagged near Bartoo Island with the remainder being tagged at Four-mile and Eight-mile islands.

A total of 20 tagged lake trout were reported in 1999. All had been tagged in Priest Lake between 1980 and 1999 (Table 10). Lake trout were caught from 0 to 15 km from their original capture site, with an average distance from original capture of approximately 3 km. Growth ranged from 0 to 3.5 cm/year, with an average annual growth of 1.3 cm/year.

Table 7. Kokanee population estimates based on midwater trawling from 1981 through 1998 in Spirit Lake, Idaho.

Year	Age Class				Total	Age-3+/ha
	Age-0	Age-1	Age-2	Age-3		
1999	286,900	9,700	50,400	34,800	381,800	61
1998	28,100	62,400	86,900	27,800	205,200	49
1997	187,300	132,200	65,600	6,500	391,600	11
1996	--	--	--	--	--	--
1995	39,800	129,400	30,500	81,400	281,100	142
1994	11,800	76,300	81,700	19,600	189,400	34
1993	52,400	244,100	114,400	11,500	422,400	20
1992	--	--	--	--	--	--
1991	458,400	215,600	90,000	26,000	790,000	45
1990	110,000	285,800	84,100	62,000	541,800	108
1989	111,900	116,400	196,000	86,000	510,400	150
1988	63,800	207,700	78,500	148,800	498,800	260
1987	42,800	164,800	332,800	71,700	612,100	125
1986	15,400	138,000	116,800	35,400	305,600	62
1985	149,600	184,900	101,000	66,600	502,100	116
1984	3,300	16,400	148,800	96,500	264,900	168
1983	111,200	224,000	111,200	39,200	485,700	68
1982	526,000	209,000	57,700	48,000	840,700	84
1981	281,300	73,400	82,100	92,600	529,400	162
Previous0	152,719	152,288	109,079	58,000	472,090	101

Fry releases: 1994 - 383,550
1988 - 75,000
1987 - 60,800
1986 - 57,142
1985 - 109,931
1984 - 100,000

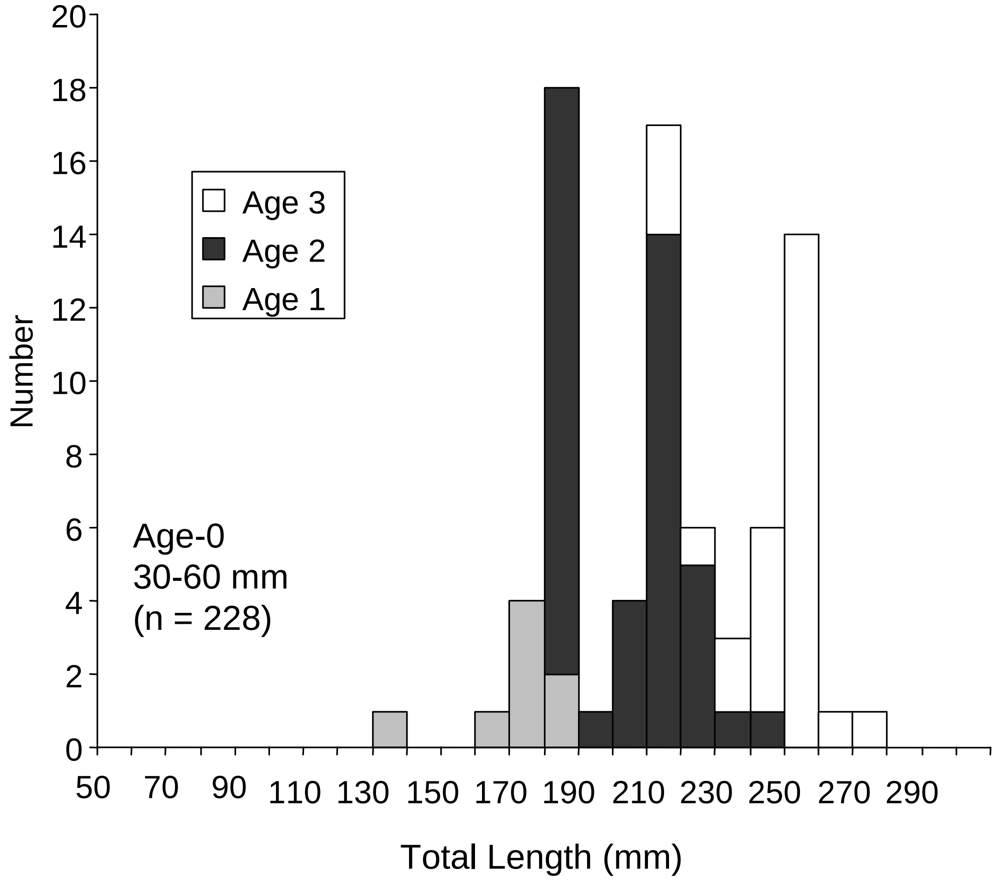

Figure 9. Length frequency and age distribution of kokanee midwater trawling in Spirit Lake, Idaho in August

Table 8. Angler effort, harvest (∀ 95% confidence range), and catch rates for the Spirit Lake, Idaho fishery, January through September 1999.

Period	Effort (rod hours)	Harvest		Catch rate (fish/h)
		Kokanee	Other	
January	8,478 (∀ 6,395)	27,986 (∀ 22,806)	1,475	3.3
February	18,986 (∀ 9,080)	83,387 (∀ 45,117)	1,803	4.4
March	11,294 (∀ 4,518)	26,767 (∀ 13,026)	2,168	2.4
April	5,590 (∀ 3,917)	2,957 (∀ 7,444)	1,856	0.5
May	12,004 (∀ 10,603)	7,166 (∀ 9,975)	1,381	0.6
June	9,133 (∀ 6,829)	6,201 (∀ 5,625)	1,224	0.7
July	6,838 (∀ 2,347)	4,561 (∀ 1,566)	0	0.7
August	2,866 (∀ 1,558)	2,528 (∀ 2,690)	272	0.9
September	6,834 (∀ 4,033)	0	0	0.0
TOTAL	82,023 (∀ 18,503)	161,553 (∀ 54,052)	10,179	1.1

Table 9. A comparison of angler effort, harvest and catch rates of the Spirit Lake kokanee fishery during creel survey periods of 1992 and 1999.

Period	Effort (rod hours)		Kokanee harvest		Catch rate (fish/h)	
	1992	1999	1992	1999	1992	1999
January	--	8,478	--	27,986	--	3.3
February	--	18,986	--	83,387	--	4.4
March	--	11,294	--	26,767	--	2.4
April	11,035	5,590	40,244	2,957	3.6	0.5
May	4,756	12,004	19,360	7,166	4.1	0.6
June	5,833	9,133	10,239	6,201	1.8	0.7
July	2,803	6,838	7,186	4,561	2.6	0.7
August	4,604	2,866	9,689	2,528	2.1	0.9
September	2,306	6,834	15,877	0	6.9	0.0
TOTAL	31,337	82,023	102,595	161,553	3.3	1.1

Table 10. Lake trout tag returns, growth, and original release site, Priest Lake, Idaho, 1999.

		Mark			Recapture			Growth (mm)		
Tag #	(color)	Date	Length (mm)	Location	Date	Length (mm)	Location	Total	Annual	Distance (km)
R1-174	(blue)	10/95	502	NE Bartoo	5/15	635	Huck. Bay	137	35	13
R1-284	(blue)	7/97	470	8-mi. Is.	4/24	500	8-mi. Is.	30	18	0
R1-088	(blue)	9/95	476	NE Bartoo	5/31	572	Kal. Is.	96	28	3
1247	(brown)	11/87	776	Kal. Is.	5/31	800	Kal. Is.	24	2	0
R1-31	(blue)	9/95	460	8-mi. Is.	8/15	508	Indian Cr.	48	10	2
R1-44	(blue)	9/95	438	NE Bartoo	8/3	533	Beaver Cr.	95	18	19
R1-37	(blue)	9/95	502	SE Bartoo	8/20	584	W. Twin. Is.	82	20	15
R1-29	(green)	9/98	465	NE Bartoo	8/24	--	8-mi. Is.	?	?	3
R1-160	(blue)	10/95	508	NE Bartoo	9/11	520	8-mi. Is.	12	4	3
00155	(yellow)	11/87	610	?	7/1	--	--	?	?	?
C-11654	(jaw)	?	?	?	9/8	838	South end	?	?	?
R1-81	(green)	6/99	450	SE Bartoo	9/6	432	South end	0	0	?
R1-309	(blue)	8/99	391	NE Bartoo	9/15	356	NE Bartoo	0	0	0
R1-1306	(yellow)	10/95	445	SE Bartoo	10/3	584	4-mi. Is.	139	36	3
R1-201	(blue)	9/95	559	Bear C. Bay	7/99	686	4-mi Is.	127	32	14
R1-66	(blue)	9/95	400	Bartoo Is.	7/99	?	4-mi Is.	?	?	?
R1-238	(green)	9/99	490	Bartoo Is.	10/99	500	Cav. Bay	-	?	3
H-098	(jaw)	10/86	668	Pinto Pt.	10/11	711	Cav. Bay	43	3	8
H-449	(jaw)	11/80	4.5 kg	NE Bartoo	10/1	9.5 kg	Thorofare	5.0 kg	0.26 kg	24

Hauser Lake

Lake Characteristics and Management--Hauser Lake is a 253 ha lake located northwest of Coeur d'Alene near the Washington border (Figure 10). The lake is relatively shallow with a mean depth of 6.4 m and a maximum depth of 12.2 m. Hauser Lake is used extensively by water skiers, jet skiers, and pleasure boaters as well as anglers. Public access to Hauser Lake is limited to a single boat launch on the south side. Because of the proximity to the Spokane Valley, much of the use is by Washington residents.

About 75% of the shoreline is rocky and intermittently vegetated. The remaining 25% of the shoreline is gradually sloped and marshy. Around 50% of the shoreline is developed in seasonal and year-round residences. Hauser Lake is a closed system in that the inlets are small tributaries and the outlet drains into the Rathdrum Aquifer before reaching the Spokane River.

Hauser Lake is a popular yield fishery, managed mainly for consumptive angling opportunity. From April through September 1993, anglers fished an estimated 60,670 h (∀11%), or 240 h/ha, which is comparable pressure to some of the most heavily fished lakes in the state (Nelson et al. 1996). The lake supports a diverse warmwater fishery as well as hatchery-supported trout, tiger muskie, and channel catfish fisheries. In 1993, rainbow trout *O. mykiss* were the most abundant fish in the harvest, comprising 33% of the total. The lake has been heavily stocked with catchable rainbow trout and fingerling rainbow and cutthroat trout annually.

Tiger muskies and channel catfish were first introduced in 1989. The intent was to utilize the abundant forage base (mainly pumpkinseeds and yellow perch) to produce a yield fishery for channel catfish and a limited trophy fishery for tiger muskies. In 1993, the first reported legal tiger muskie was caught (a 3.5 kg fish) which became the first state record. By 1999, the state record had been reset several times by Hauser Lake fish and was a 15.6 kg fish at the end of 1999 (Figure 11). The trophy size of the fish has generated tremendous media and angler interest in tiger muskies in the past two years. Simultaneously, we have heard complaints by perch and crappie anglers that the quality of the yield-oriented pan fishery has deteriorated. A goal of the 1999 survey was to evaluate abundance and size structure of the yellow perch and black crappie populations in comparison with a fish population survey in 1992.

Limnological Characteristics--Hauser Lake is a meso-eutrophic lake with Secchi disk visibility averaging 3.5 m on August 25 and a conductivity of 32 μmhos. The lake was gradually stratified, with a broad metalimnion, no anoxic zone and temperature ranging from 8 to 22^{o}C. Suitable trout habitat in late August was limited to the metalimnetic zone approximately 4-7 m from surface because of high epilimnetic temperatures and low hypolimnetic oxygen levels. Total dissolved solids (TDS) was 20 and pH was 7.5.

The zooplankton indices (ZPR and ZQI) both indicate moderate to high zooplankton abundance and quality. The ZPR was 0.25, and the ZQI was 0.625. Both indices indicate that current stocking levels are appropriate for the productivity of the lake (Teuscher 1999).

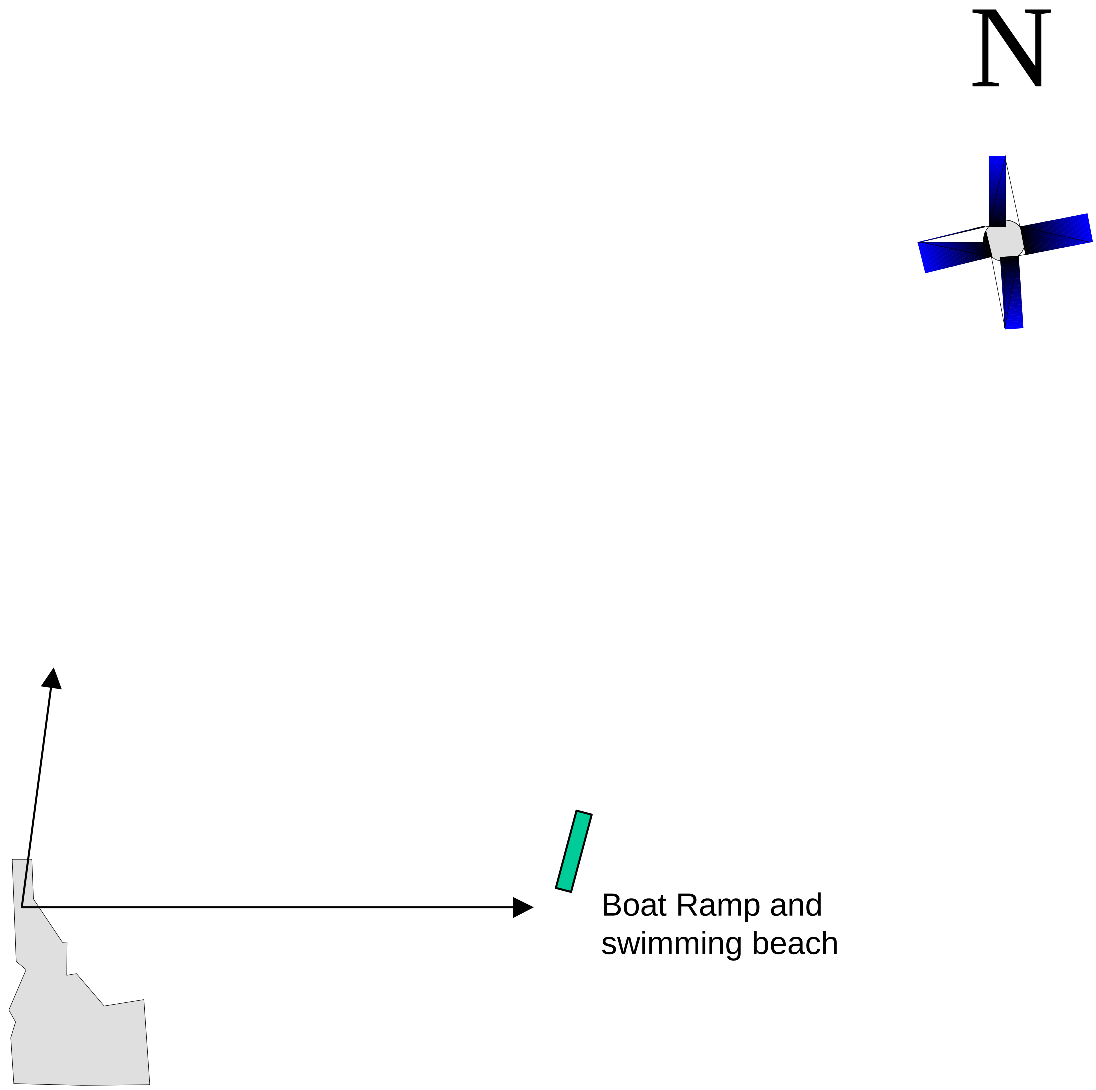

Figure 10. Map of Hauser Lake, Idaho.

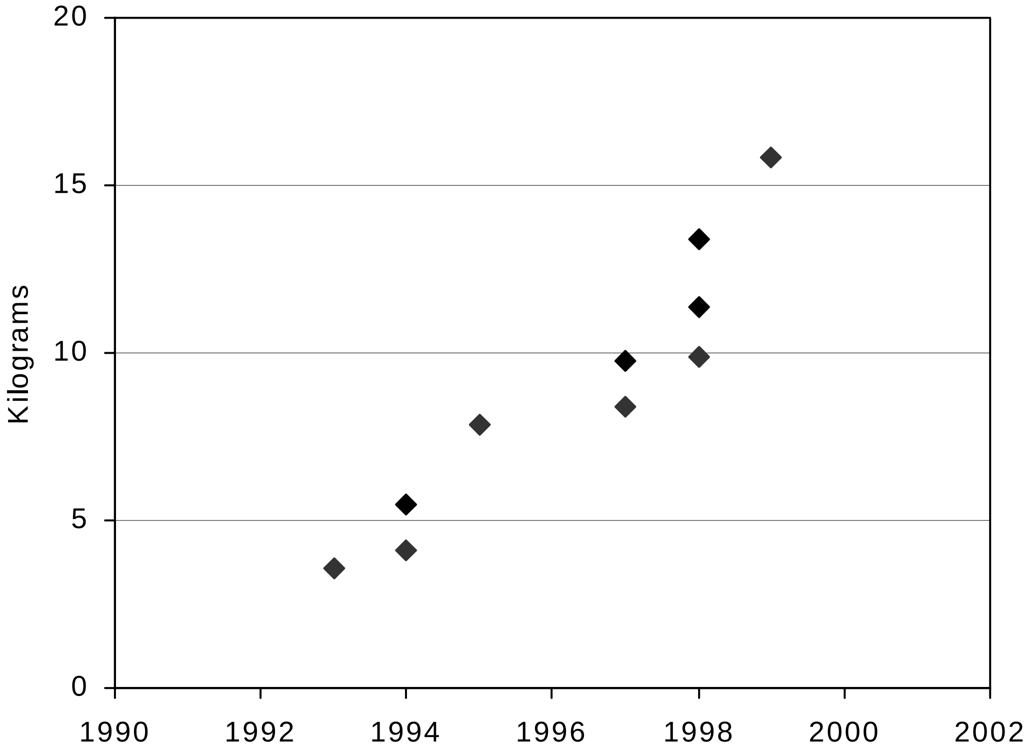

Figure 11. Weight of state record tiger muskies captured in Hauser Lake, Idaho, from 1993 to 1999.

Fishery Characteristics--We collected 420 fish weighing approximately 91.2 kg per unit of combined gear sampling effort (one hour of electrofishing, one floating and one sinking gill net, and one trap net). Game species comprised 93% of the sample based on number and 72% of the sample based on weight. Tench *Tinca tinca* were the only non-game species collected. Pumpkinseeds were the most abundant species in the sample based on number, and largemouth bass *Micropterus salmoides* were the most abundant species based on sample weight. Length, weight, catch per unit of effort for individual fish species and sampling locations of each gear type are detailed in Appendix A.

We collected 108 largemouth bass (26% of the total sample) per combined unit of sampling effort, ranging from 90 to 435 mm in length. Sample weight was 20 kg, or 22% of the total sample weight. Proportional stock density (PSD; Anderson 1980) was 11 and RSD-400 was 2, suggesting high exploitation of legal size (305 mm) largemouth bass. Relative weight was 94-97 g, indicating slightly below average weight of the Hauser Lake population.

We collected 62 yellow perch per unit of effort, ranging from 80 to 245 mm. Yellow perch comprised almost 15% of the sample by number and about 2% of the sample by weight. Proportional stock density was 29. Relative weight was 83-84 g, indicating below average condition of the population.

We collected 47 black crappie per unit of effort, ranging from 70 to 275 mm. Black crappie comprised 11% of the sample by number and 8% of the sample by weight. Size structure of black crappie was heavily weighted toward quality-size fish (200 mm) with a PSD of 95 and an RSD-250 of 4.

Comparison with 1992 Survey--As expected, channel catfish and tiger muskies comprised a much greater portion of the sample weight than in 1992, when no tiger muskies were detected and channel catfish were less than 2% of the sample weight. In 1999, we collected only 1.3 tiger muskies per unit of effort—much less than 1% of the total—but because they ranged from 0.9 to 12.7 kg, tiger muskies comprised almost 13% of the sample weight in 1999 (Table 11). Numerically, channel catfish comprised around 2% of the sample both in 1999 and in 1992; however, the 1999 sample was a much larger portion of the total sample weight (8%) than it was in 1992 (<2%). This reflects the growth of the channel catfish population, which was originally stocked in 1989 (Figure 12). We collected channel catfish up to 660 mm in length and 3.75 kg, which is much larger than in the 1992 sample, when 370 mm and 0.6 kg was the largest fish. Relative weight of larger channel catfish was above average for fish greater than 500 mm (Anderson 1980; Figure 13).

We saw no evidence the yellow perch and black crappie populations have been negatively affected by channel catfish and/or tiger muskies. Both numerically and by weight, yellow perch comprised similar portions of the sample in 1999 and 1992 (Table 11), although PSD of the sample declined from 43 in 1992 to 29 in 1999. Abundance and size structure of black crappie appears to have improved since 1992. Black crappie actually comprised a much greater portion of the sample in 1999 than in 1992, and the PSD of black crappie increased from 55 in 1992 to 95 in 1999. Rainbow trout, pumpkinseeds, green sunfish *Epomis cyanellus*, and brown bullheads *Ameiurus melas* all comprised very similar portions of the 1992 and 1999

Table 11. Comparison of Hauser Lake, Idaho, fishery characteristics between 1992 (Horner et al. 1996) and 1999 based on standard lowland lake survey samples.

Species	Maximum size		% of total sample (by number)		% of total sample (by weight)	
	1992	1999	1992	1999	1992	1999
Yellow perch	250	245	18.6	14.7	2.2	2.1
Black crappie	90	275	2.3	11.1	1.1	8.0
Tiger muskie	--	1,110	0	0.3	0	12.7
Channel catfish	370	660	1.7	2.1	2.2	7.9
Largemouth bass	450	435	16.3	25.8	11.8	22.0
Rainbow trout	350	395	1.6	1.6	2.6	2.8
Brown bullhead	330	325	10.3	6.9	11.7	9.0
Tench	450	465	15.4	7.2	60.7	28.0
Green sunfish	140	105	1.4	<1	<1	<1
Pumpkinseed	195	200	32.3	30.0	7.3	7.5

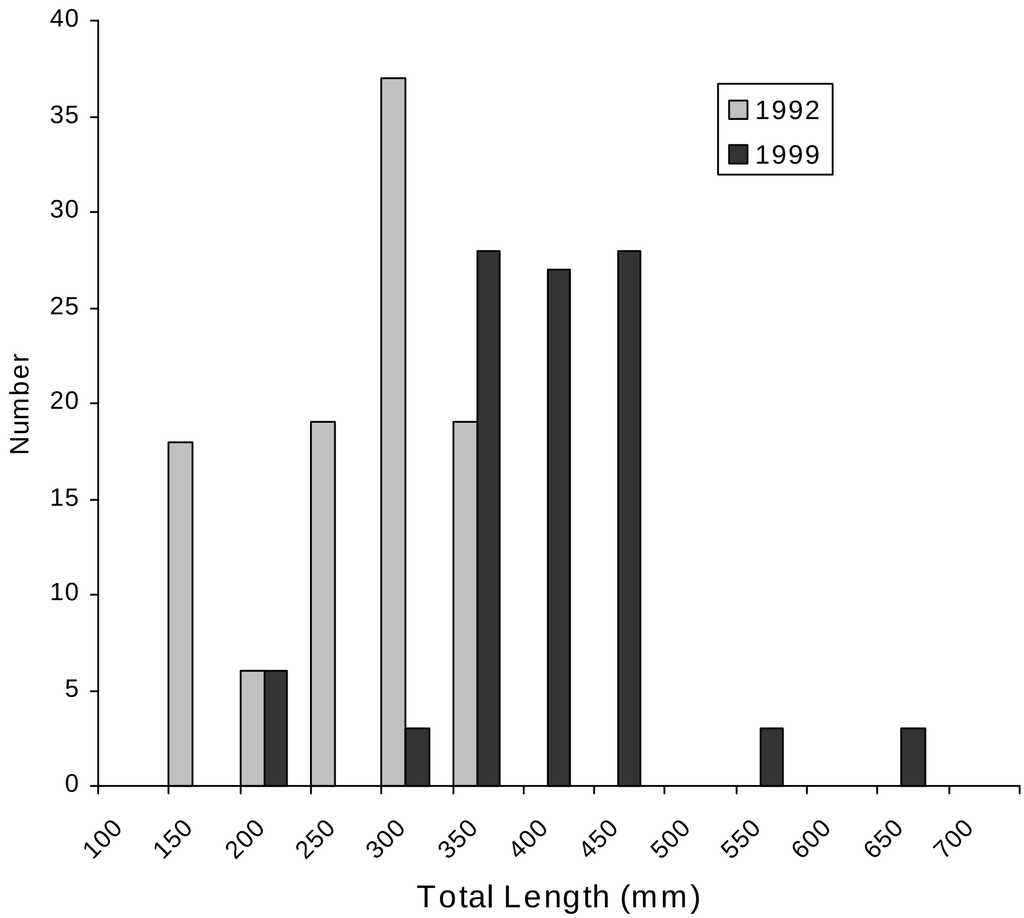

Figure 12. Length frequency of channel catfish collected from Hauser Lake, Idaho, during standard lake surveys in 1992 and 1999.

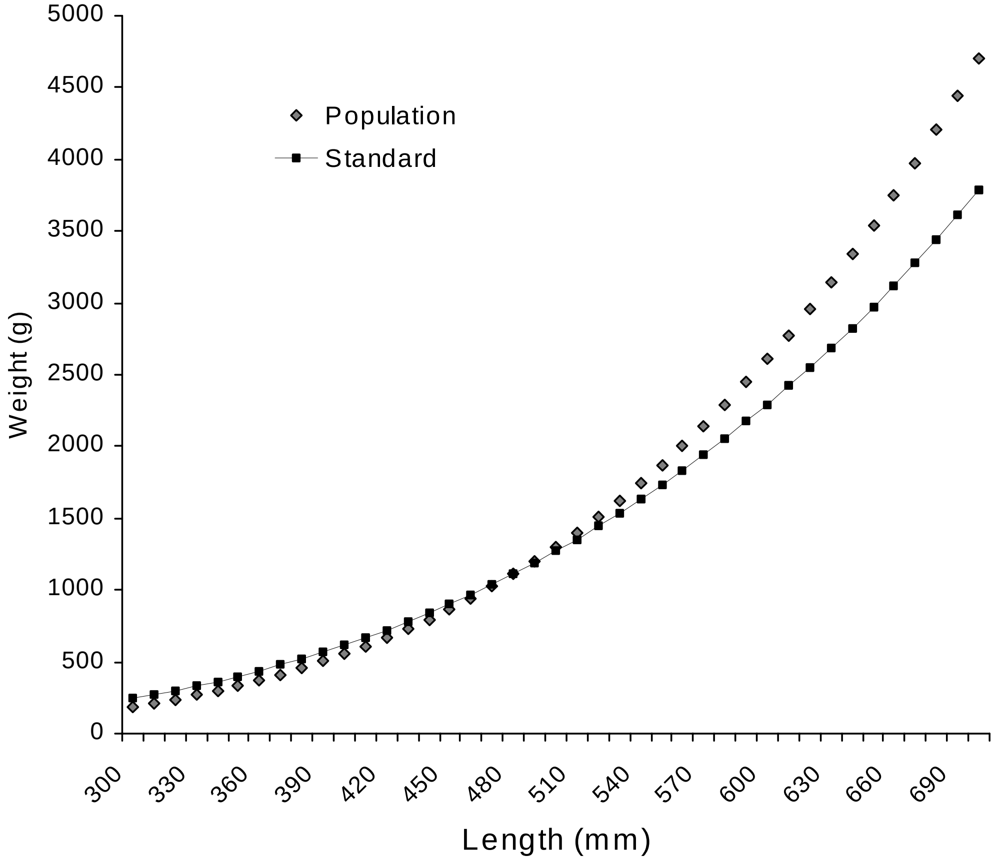

Figure 13. Length-weight relationship of channel catfish collected from Hauser Lake, Idaho, in 1999 compared with the standard length-weight relationship (Anderson 1980).

samples. The only species that showed a marked decline in relative abundance since 1992 were largemouth bass and tench. Not only were largemouth bass less abundant than in 1992, but the stock quality indices in 1999 (PSD and RSD-400) were approximately half of those in the 1992 survey (23 and 4, respectively; Davis et al. 1996). This suggests the decline in largemouth bass population is more related to exploitation than to the introduced piscivores.

Upper Priest Drainage Exotic Fish Control Evaluation

Upper Priest Lake Gillnetting

We netted and removed a total of 321 lake trout in the five netting efforts. Weekly catch ranged from 48 to 108 lake trout (Table 12). Standardized catch ranged from 0.7 to 1.6 fish/hr/100 m^2, with no apparent trend or evidence of depletion. Mean catch rate throughout the 1999 effort was 0.95 fish/hr/100 m^2, similar to the catch rates in the fall of 1998 (Figure 14), and only slightly lower than the cumulative catch rate throughout the 1998 effort of 1.1 fish/hr/100 m^2. Size of lake trout ranged from 181 to 900 mm (TL), with a modal size of 275 mm (Figure 15). The mean size in 1999 of 447 mm (n=321) was not significantly different than mean size in 1998 of 439 mm (n=895, T-test, P=0.38).

In Upper Priest Lake we recaptured six lake trout of the 112 fish originally tagged in 1997, bringing the total number of recaptures during the 1998 and 1999 netting efforts to 20 (18% of total). An additional fish was caught by an angler in Priest Lake, bringing the total number of fish recaptured in Priest Lake to five (4.5% of total). We incidentally netted 15 bull trout during the lake trout netting efforts. The ratio of bull trout to lake trout was 4.7:100, which is very similar to the cumulative ratio in 1998 of 5.0:100. We had no bull trout mortality.

Thorofare Evaluation

Gillnetting--We captured a total of 12 lake trout from the Thorofare in 1999. Lake trout ranged from 279 to >850 mm total length (TL). The largest lake trout caught weighed 9.5 kg (this fish was previously jaw tagged by IDFG in 1980 in the southern portion of Priest Lake and grew 5 kg in the 19 years since being tagged). One fish was caught on August 3 and the rest in October. Ten of the 11 lake trout caught in October were caught at night, while the other two lake trout were caught at dawn. Surface water temperatures when lake trout were caught were 20°C in August and 8°C in October.

We captured a total of 29 cutthroat trout. No cutthroat trout were caught in June, seven were caught in July, 16 were caught in August, four were caught in September, and two were caught in October. CPUE was highest in August and lowest in June (Table 13). Fifty-two percent (n = 15) of cutthroat trout were caught during daylight hours, 31% (n = 9) at dusk, 10% (n = 3) at night, and 7% (n = 2) at dawn. However, CPUE was highest at dusk (0.38 fish/h), followed by daylight, dawn, and night (Table 13).

Table 12. Number of lake trout and bull trout captured during the 1998 and 1999 gillnetting efforts in Upper Priest Lake, Idaho. Recaptured lake trout were those marked in 1997.

		Lake trout			Bull trout	
Sample week	Dates	Capture	Standardized catch rate[a]	Recapture	Capture	Blt:Lkt ratio
1	Jun 8-10, 1998	83	1.24	2	0	0.0:100
2	Jun 15-17, 1998	60	0.98	1	1	1.6:100
3	June 22-24, 1999	90	1.30	1	3	3.3:100
4	Jun 30- Jul 1, 1998	35	0.69	0	1	2.8:100
5	Jul 7-9, 1998	53	0.83	1	3	5.7:100
6	Jul 13-15, 1998	132	1.13	4	6	4.3:100
7	Sep 21-24, 1998	163	2.00	0	11	6.3:100
8	Sep 28-30, 1998	62	0.88	1	10	13.8:100
9	Oct 13-15, 1998	56	0.80	2	3	5.1:100
10	Oct 20-22, 1998	42	0.61	1	2	4.5:100
11	Oct 28-29, 1998	56	1.65	0	4	6.7:100
12	Nov 4-5, 1998	51	0.94	1	0	0.0:100
13	Nov 10-11, 1998	29	0.99	0	2	6.5:100
1998 Totals		912	1.10	14	46	5.0:100
14	Jun 3-4, 1999	48	1.03	1	2	4.2:100
15	Jun 15-16, 1999	49	0.68	0	2	4.1:100
16	Jun 21-23, 1999	108	0.93	2	3	2.8:100
17	Jun 30-Jul 1, 1999	50	1.64	1	0	0:100
18	July 6-8, 1999	66	0.90	2	8	12.1:100
1999 Totals		321	0.95	6	15	4.7:100

[a] Because of the shift to longer and deeper nets, we standardized catch rate to fish/h/100 m^2 of gill net.

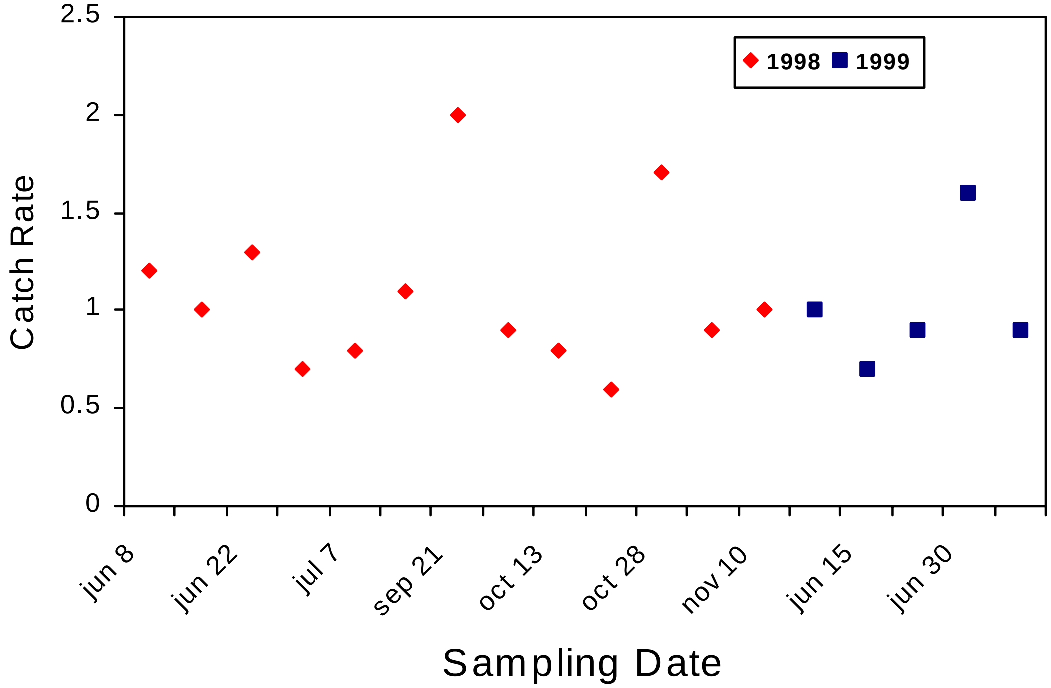

Figure 14. Standardized catch rates (fish/h/100 m^2 of gill net) of lake trout from Upper Priest Lake, Idaho, in 1998 and 1999.

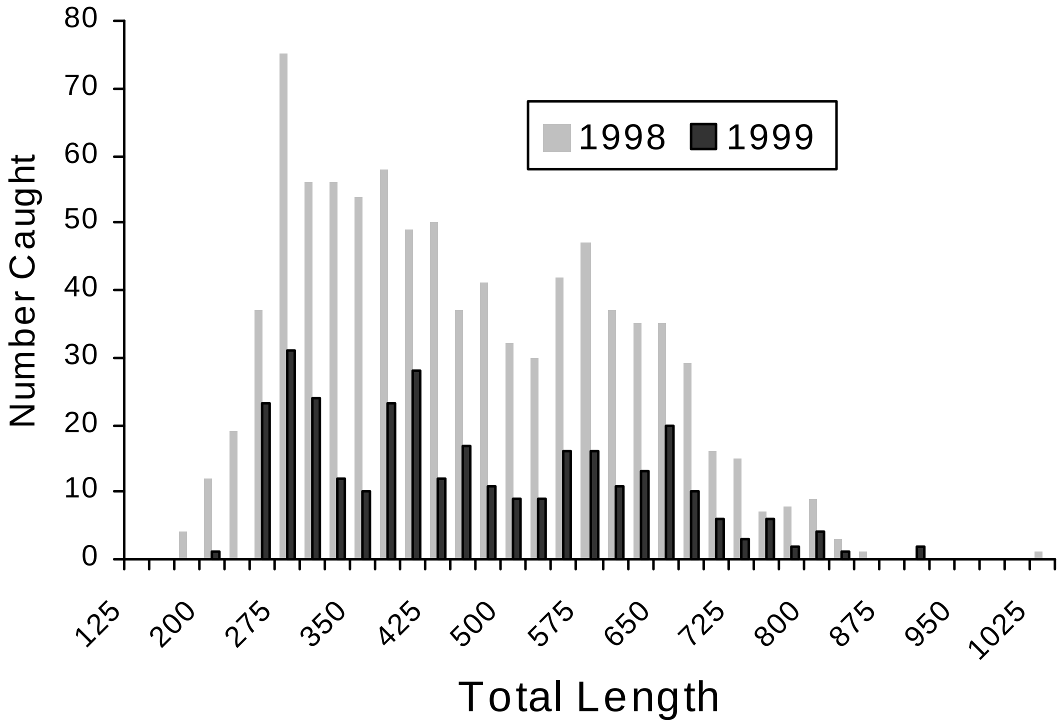

Figure 15. Length frequency of lake trout collected in gill nets in 1998 and 1999 from Upper Priest Lake, Idaho.

Table 13. Number of cutthroat trout captured during 1999 gillnetting efforts in the Thorofare, Priest Lake, Idaho.

	Dawn		Day		Dusk		Night		Total	
Month	Capture	CPUE	Capture	CPUE	Capture	CPUE	Capture	CPUE	Capture	CPUE
Jun	0	0.000	0	0.000	0	-	0	-	0	0
Jul	0	-	5	0.172	2	0.362	0	0.000	7	0.160
Aug	1	0.067	8	0.321	6	0.402	1	0.042	16	0.204
Sept	1	0.274	2	0.119	1	0.303	0	0.000	4	0.090
Oct	0	0.000	0	0.000	0	-	2	0.080	2	0.047
Total	2	0.066	15	0.156	9	0.379	3	0.038	29	0.127

Only one bull trout was caught during the netting effort. This fish was caught on September 20, 1999 during daylight hours when the surface water temperature was 16°C. It was 312 mm TL and weighed 310 g.

Other species captured included northern pikeminnow *Ptychocheilus oregonensis*, mountain whitefish *Prosopium williamsoni*, tench, largescale sucker *Catostomus macrocheilus*, peamouth chub *Milocheilus caurinus*, and yellow perch. Nets yielded 156 northern pikeminnows, 11 mountain whitefish, seven tench, 28 largescale suckers, 84 peamouth chubs, and two yellow perch.

Electrofishing--The two electrofishing passes combined for 103 minutes of effort in the Thorofare. The water temperature was 19.5°C. We captured nine largescale suckers, six northern pikeminnow, 10 redside shiners *Richardsonius balteatus*, three mountain whitefish, one pygmy whitefish *P. coulteri*, and one yellow perch.

Tributary Electrofishing

Rock Creek--We removed 34 brook trout in a single electrofishing pass on Rock Creek. We captured and returned 111 cutthroat trout and three bull trout. Brook trout comprised 23% of the total catch in 1999, compared with 38% in 1998 (Figure 16). Cutthroat trout comprised 75% of the catch in 1999 compared with 60% in 1998, and bull trout comprised 2% of the catch in both years. The 1999 species composition showed a significant decrease in the relative abundance of brook trout from the first pass in 1998 (Chi-square, $P<0.01$). The total catch in 1999 of 148 fish was lower than the total catch during the first electrofishing pass in 1998 of 214 fish. Based on size distribution, we believe the lower total catch is the result of our inability to capture age-0 fish in 1999 because of their small size. This is likely a function of the timing of the 1999 effort (late July), compared with 1998 (late August).

Ruby Creek--We captured and removed 117 brook trout in the single pass on Ruby Creek. We incidentally captured and returned 101 cutthroat trout. Brook trout comprised 54% of the catch in 1999 compared with 81% of the catch in 1998 (Figure 17). Cutthroat trout

Figure 16. Percentage of brook trout and cutthroat trout collected in Rock Creek, a tributary to the Upper Priest River, Idaho, before (1998) and after (1999) brook trout removal efforts.

Figure 17. Percentage of brook trout and cutthroat trout collected in Ruby Creek, a tributary to the Upper Priest River, Idaho, before (1998) and after (1999) brook trout removal efforts.

comprised 46% of the catch in 1999 compared with 19% in 1998. As with Rock Creek, the 1999 species composition showed a significant decrease in the relative abundance of brook trout from the first pass in 1998 (Chi-square, $P<0.01$). No bull trout were caught in 1999, compared with two (<1% of catch) in 1998. As with Rock Creek, we caught very few age-0 fish in 1999.

DISCUSSION AND RECOMMENDATIONS

Coeur d'Alene Lake Kokanee and Chinook

Based on midwater trawl estimates, the kokanee population is continuing to show a rapid recovery from the impacts of the high runoff events of 1996 and 1997. Although age-3 and age-2 kokanee are still well below average, the age-1 and age-0 kokanee year classes are at or near the long-term averages. Because of the apparent compensatory response in kokanee growth, survival and fecundity, indications are that the kokanee population will recover in a single generation. We do not expect to see a long-term instability resulting from one or more weak age-classes. A full single-generation recovery of the kokanee population, however, will depend largely on the fry emerging in 2000. The spawning escapement in 1999 was the weakest since trawling began, and the PED was only around 19 million eggs. To produce an average year-class of fry, the PED-to-fry survival will have to be around 18%. Although this is much higher than the Coeur d'Alene Lake average of around 3%, the 1999 survival of almost 16% suggests that extremely high compensatory survival is possible. Furthermore, because of the size of mature kokanee (300-340 mm) in the 1999 trawl effort and the decreased capture efficiency with increasing size (Rieman 1992), we most likely underestimated the population of spawners. This suggests escapement of 1998 and 1999 spawners was greater than trawl-based estimates indicate and may partially account for the exceptionally high PED-to-fry survival rate in 1999.

Recommendations

1. Stock 28,200 age-0 chinook salmon in 2000 to supplement the estimated 6,800 naturally produced fish for a combined total of 35,000 age-0.

2. Continue to monitor the recovery of the kokanee population and adjust age-0 chinook salmon supplementation accordingly.

3. Continue to encourage catch-and-keep chinook fishing.

Spirit Lake Kokanee

The creel survey indicated that harvest in 1999 was substantially greater than past years. Creel surveys from 1949-1981 all estimated a total kokanee harvest of less than 60,000 fish. The 1992 and 1999 respective estimates of 102,000 and 162,000 kokanee suggest the fishery has increased in popularity in recent years. Based on midwater trawl population estimates, the harvest in recent years exceeds the sustainable yield, resulting in two major problems. The first problem is one of allocation. Traditional summer anglers have increasingly reported a lack of mature kokanee in recent years, corresponding the increasing popularity of the winter and spring fisheries. This contention is supported by the creel survey that indicated less than 10% of the 1999 kokanee were caught from June through September, even though the same time period accounted for nearly one-third of the effort. The extensive ice-fishery in 1999 demonstrates the potential for high exploitation in a very short period of time. The second problem is that over harvest may result in insufficient escapement and reproduction. Spirit Lake has few large piscivorous fish and presumably a low natural mortality of kokanee. Therefore, subtracting the estimated mean escapement (late summer estimate of age-3 kokanee) from the mean age-1 population since 1981 gives a crude estimate of overall average annual harvest since 1981. Using this method, annual harvest has been approximately 94,000 fish, further supporting the evidence that harvest in recent years is well over the long-term average and likely exceeds available surplus.

Unfortunately, harvestable surplus varies widely from year to year. In recent years the kokanee population has developed a particularly weak year-class every fourth year. Based on the lower end of the target adult kokanee range (30-50 fish/ha) defined by Rieman and Maiolie (1995), the *minimum* escapement is around 20,000 age-3 kokanee. Subtracting this from the age-1 population illustrates the variability in surplus—a range from zero to 265,000. The weak year-class of age-1 kokanee in 1999 is one that cannot withstand any significant harvest and portends a very poor fishery and spawner escapement in 2001. This is likely a result of very poor escapement in 1997 that we believe is related to an extensive winter and spring fishery earlier that year that targeted an already weak age-class.

The cyclic trend will likely continue without a reduction in harvest and successful supplementation of the age-0 kokanee in 2002. We believe the rule changes for 2000 (15 kokanee limit with kokanee season of last Saturday in April through February 15) will effectively reallocate the harvest throughout the year. Contingent on availability, early spawning kokanee fry will be supplemented in Spirit Lake. We don't expect early spawners to contribute significantly to natural reproduction because of the limited early spawner tributary habitat. These fish will hopefully contribute significantly to the fishery and minimize harvest of naturally produced late spawning kokanee.

Recommendations

1. Stock up to 250,000 age-0 kokanee when available to supplement naturally produced fry.

2. Assess effectiveness of the kokanee rule changes through trawl-based population monitoring and future creel surveys.

<u>Hauser Lake</u>

The standard lake survey in 1999 did not confirm reports of declining yellow perch and black crappie populations. If the 1992 survey was an accurate indicator of the baseline fisheries community (i.e. before effects of tiger muskies and channel catfish were evident); then the only species with notable decreases in relative abundance were tench and brown bullheads.

Initial tiger muskie stocking rates in 1989 and 1990 were around 6 fish/ha. The age-class stocked in 1989 is not believed to have survived because of the poor condition of fish when stocked. The 1990 age-class seems to have survived well, and scale analysis indicates that the state record tiger muskies have been from this group of fish. In 1991, stocking was decreased to 2 fish/ha on alternate years. Evidence that this enormously popular trophy tiger muskie fishery comes at the expense of the yield-oriented yellow perch and black crappie fisheries is still inconclusive. However, a reduction in tiger muskie density would insure an abundant forage base and decrease the potential for reduced tiger muskie and channel catfish growth rates, and would decrease the possibility of negatively affecting the panfishery in future years. Based on the abundance and growth rates of tiger muskies and channel catfish in the survey and the apparent high survival of stocked fish, we believe that a reduction in stocking rates to 2 tiger muskies/ha every third year would still be sufficient to maintain a quality fishery.

Recommendations

1. Reduce tiger muskie stocking rates to 550 fish every third year.

2. Continue to stock 8,000 channel catfish on alternate years.

3. Conduct standard lake survey in 5-7 years to monitor changes in abundance, growth, and size of the Hauser Lake fish community.

Upper Priest Drainage Exotic Fish Control Evaluation

The 1999 gillnetting results confirmed the importance of controlling lake trout immigration in the Thorofare if reduction efforts are to be effective. Initial estimates of the 1998 removal effort, assuming a closed population, indicated that we had removed around 75% (∀25%) of the lake trout population. However, the 1998 biotelemetry and spaghetti tag recoveries refuted the closed population assumption. In 1999, we saw no strong evidence that the lake trout population had been significantly impacted by the 1998 effort. Gill net catch rates were comparable to catch rates in May 1998 when we began the project. We saw no evidence of shifting size structure due to high exploitation in 1998, and the lake trout:bull trout ratios were not indicative of a substantial lake trout population reduction.

Our capture of lake trout in the Thorofare in October and failure to capture lake trout during the summer months was largely expected based on thermal preferences of lake trout (Bjornn 1957; Snucins and Gunn 1995; Olsen et al. 1988). Lake trout often avoid warmer temperatures during summer and concentrate in cooler, deeper water (Martin 1957, Bjornn 1957). We thus expected to capture fewer lake trout in the Thorofare during the warm summer months. We expected to capture lake trout in the fall when the spawning migration occurs after surface water temperatures cooled to the preferred temperature range of lake trout.

Despite cooler water temperatures (5°C to 8°C), we were unable to capture any lake trout in June. This is very possibly related to the amount of effort and inefficiency of the sampling equipment in June. High flows in the Thorofare decreased the effectiveness the gill nets, and the June sampling effort was not extensive and occurred only during daylight hours. Another possibility is that lake trout may not have been using the Thorofare at this time even though temperature should not have limited fish movement. This seems likely if increased Thorofare use in the fall is related to spawning activity.

The disproportionate number of lake trout caught during nighttime sampling was not unexpected. In daylight, fish are easily visible in the Thorofare from a boat, since the Thorofare is 2 m deep and most of the bottom is easily visible. For this reason frequent movement of fish through the Thorofare was not expected during daylight hours, as there is little cover and fish would be exposed. Cutthroat trout, however, did frequently use the Thorofare in daylight and at dusk. We observed a significant insect hatch in the Thorofare during evening hours, suggesting that cutthroat trout may have been utilizing the Thorofare primarily for feeding.

The single bull trout caught in September indicates that bull trout do use the Thorofare. The fish was caught in daylight when the surface water temperature was 16°C. Bjornn (1957) reported that bull trout were not found near the surface when surface water temperatures were >13°C. The temperature suggests the bull trout may have been migrating through, rather than residing in the Thorofare.

The brook trout removal evaluation afforded conflicting interpretations regarding the effectiveness of removal efforts on Rock and Ruby creeks. We did find statistically significant improvements in the species compositions. This is not surprising considering that we removed an estimated 90% of the brook trout in Rock Creek and around 50% of the brook trout in Ruby Creek in 1998. The removal efforts combined with the sensitivity of the Chi-square test of homogeneity made the statistically significant results expected.

The biological significance of the improvements, however, is more doubtful. This is particularly true in Ruby Creek, where we collected 117 brook trout in a single pass despite the 1998 removal efforts. Furthermore, this effort likely under represented brook trout in the stream because of the lack of fry in the catch. Our 1998 capture efficiency suggested we left between 765 and 2,567 brook trout in Ruby Creek. Brook trout are characterized by an early age-at-maturity, often spawning at age-2 (Scott and Crossman 1973). In contrast to lake trout, which are easily over-exploited (Healey 1978), brook trout are very difficult to over exploit. The early age-at-maturity, short life span and ability to use a wide range of spawning habitats (Hausle and Coble 1976) will likely result in rapid recovery of the brook trout population in Ruby Creek. For this reason, the shift in relative abundance of brook trout and cutthroat trout likely be short-lived and is not likely biologically significant.

In Rock Creek, where the accessibility and 1998 collection efficiency was much higher, we captured 34 brook trout during a single pass. Based on 1998 population and removal estimates, we would only have left between 13 and 38 brook trout in Rock Creek. Recognizing that the 1999 capture consisted of a single pass and did not include age-0 fish, there were far more brook trout remaining in Rock Creek than we had optimistically predicted. This may be a result of an overestimation our 1998 capture efficiency, or significant immigration of brook trout to Rock Creek.

Recommendations

1. Continue to assess seasonal and diel use patterns of the Thorofare by lake trout and native fish species.

2. Develop fish migration control alternatives and evaluate feasibility of use in the Priest Lake system.

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APPENDIX

1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: I-Surveys and Inventories

Subproject: I-A Panhandle Region

Job No.: c

Title: Rivers and Streams Investigations

Contract Period: July 1, 1999 to June 30, 2000

ABSTRACT

We counted 712 bull trout *Salvelinus confluentus* redds in the Pend Oreille Lake drainage in 1999. A total of 58 redds were counted in the upper Priest Lake drainage, 69 redds were counted in the upper St. Joe River drainage, and 17 bull trout redds were counted in the upper Little North Fork Clearwater River drainage.

We collected a total of 874 salmonids with combined electrofishing and angling efforts in the Moyie River in 1999. Mountain whitefish *Prosopium williamsoni* were the most abundant species captured, comprising 74% of the total catch. Age and growth determinations were made on scales from 30 rainbow trout *Oncorhynchus mykiss* 116-507 mm TL. Wild rainbow trout and brook trout *S. fontinalis* comprised 14% and 10% of the total catch, respectively. Based on scale analysis, rainbow trout typically achieve 200 mm at age-3 and 390 mm at age-6. Relative Stock Density-13 (RSD) was 20.6% for wild rainbow trout while RSD-10 for brook trout was 37%. Estimates of return-to-creel for Floy tagged wild rainbow trout and brook trout in the Moyie River were 2.3% and 3.4%, respectively. Hatchery rainbow stocking in the Moyie River was discontinued in 1999 due to poor return rates and concerns from Canadian fish managers about IDFG stocking IPN positive fish from Clark Fork Hatchery into the Moyie system.

We electrofished the Coeur d'Alene River from the old railroad bridge above I-90 downstream to the Cataldo boat ramp during June 1999. Mountain whitefish were the most numerous species captured comprising 46% of the catch. A total of 286 westslope cutthroat trout *O. clarki lewisi* were sampled representing 44% of the two-night electrofishing catch. Forty-one cutthroat trout and cutthroat/rainbow trout hybrids 352-485 mm TL were tagged with reward tags in 1999. Estimated exploitation of cutthroat trout was 17% in 1999.

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OBJECTIVES

1. Estimate bull trout *Salvelinus confluentus* redds in Pend Oreille Lake, Upper Priest Lake, St. Joe River and Little North Fork Clearwater River drainages

2. Assess game fish species composition, growth, size structure, exploitation, distribution and abundance in the Moyie River.

3. Assess game fish species composition and exploitation of trout on the lower Coeur d'Alene River.

METHODS

Bull Trout Spawning Surveys

In 1999, bull trout redds were counted in selected tributaries based on previous surveys of the Pend Oreille Lake (Pratt 1984), Upper Priest Lake (Nelson et al. 1996), St. Joe River (Davis et al. 1996), and Little North Fork Clearwater River (LNFCR) (Davis et al. 2000) drainages. We surveyed the Pend Oreille Lake drainage October 15-22, the Upper Priest Lake drainage September 30, St. Joe River drainage September 20, and the Little North Fork Clearwater (LNFCR) drainage September 21. Survey techniques and identification of bull trout redds followed methodology described by Pratt (1984). Bonneau and LaBar (1997) conducted a study to evaluate variability in redd counts by volunteer observers. Their findings indicated level of observer training and experience may influence the accuracy of the number of bull trout redds identified as inexperienced observers counted significantly more redds than experienced observers. Based on their conclusions we utilized only experienced biologists for bull trout redd counts in established index streams. Index streams were established in 1997 on the St. Joe system, in 1994 on the LNFCR, in 1988 on the Pend Oreille drainage, and in 1992 on the Upper Priest Lake drainage. We estimated the range of adult bull trout spawners entering each drainage by applying a low estimate of 2.2 fish/redd (Bonar et. al. 1997) and an upper estimate of 3.2 fish/redd (Fraley and Shepard 1998) to the total number of redds observed.

Moyie River Assessment

In 1999 we evaluated fish populations and angler harvest in the Moyie River. Electrofishing and angling were used to assess distribution and abundance of brook trout *S. fontinalis*, rainbow trout *Oncorhynchus mykiss*, westslope cutthroat trout *O. clarki lewisi*, and mountain whitefish *Prosopium williamsoni*. The river was divided into two sections, the upper section stretching from the U.S.-Canada border downstream approximately 15 km to Twin Bridges and the lower section from Twin Bridges downstream approximately 10 km to the slack-water of Moyie Dam (Figure 1). Fish were collected using a VVP15 Coffelt variable voltage pulsator and a 5,000 watt generator mounted in the drift boat with electrodes suspended from two forward booms. The drift boat floated downstream while electrofishing adjacent to the bank.

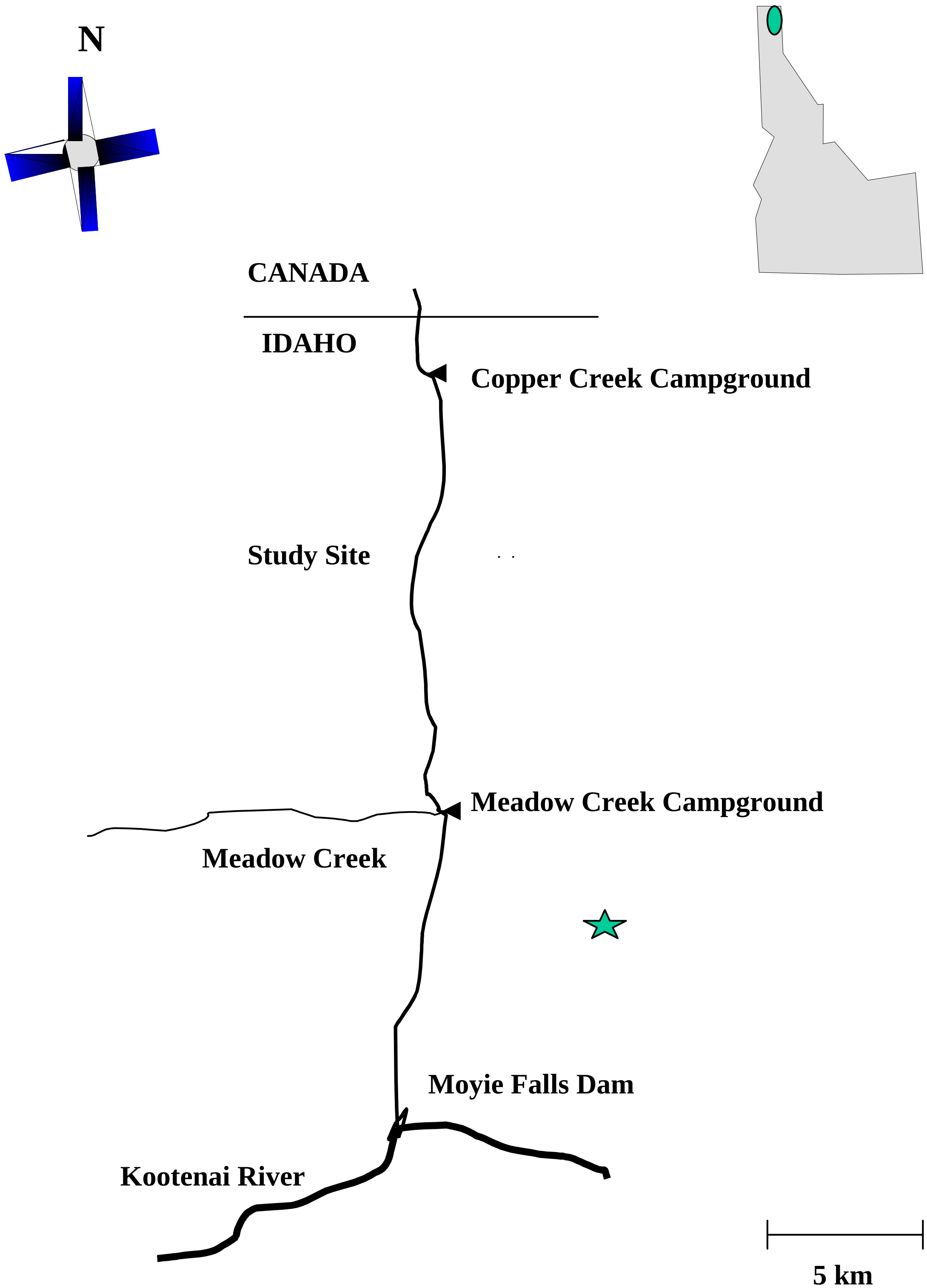

Figure 1. Location of electrofishing transects used to survey the Moyie River, Idaho, 1999.

Trout were captured by angling on July 7 and by electrofishing and angling on July 8. Salmonids collected were identified and measured (total length [TL] mm). On the first run, all fish were measured and marked with a hole punch in the caudal fin. Rainbow trout and brook trout over 200 mm were tagged with brightly colored Floy T-bar anchor style reward and non-reward tags. Mountain whitefish were marked with a lower caudal fin clip. Snorkeling was attempted on July 19 and determined to be ineffective due to poor visibility and the large size of the Moyie River. A recapture run consisting of one electrofishing pass was completed on July 19 on the upper section only. All salmonids collected were measured, examined for marks and classified into 10-mm size groups. The number of Floy tagged rainbow and brook trout were also recorded by length group.

In an effort to quantify Moyie River length-frequency data we used the stock density index Relative Stock Density (RSD) (Wege and Anderson 1978). RSD values are calculated as:

$$\mathrm{RSD} = \frac{\text{Number of fish} \geq \text{specified length}}{\text{Number of fish} \geq \text{stock length}} \times 100$$

Specified length was set at 325 mm and 250 mm (13 and 10 in) for Moyie River rainbow and brook trout, respectively. Traditional stock lengths were used for rainbow and brook trout. Stock length is defined as the approximate length at maturity, minimum length effectively sampled by traditional gear, and the minimum length of fish that provide recreational value. Stock length for rainbow trout and brook trout is defined as 8 inches (200 mm) and 5 inches (125 mm), respectively.

Fish weights were used to calculate relative weight (W_r), an index of plumpness and physiological well-being (Wege and Anderson 1978) of Moyie River rainbow and brook trout collected in 1999. W_r values are calculated as:

$$\mathrm{Wr} = \frac{\text{fish weight}}{\text{std. weight at length}} \times 100$$

Minimum lengths of 200 mm and 130 mm were used for rainbow and brook trout, respectively, in an effort to reduce differences in growth forms between juvenile and adult fish (Murphy et al. 1991).

Lower Coeur d'Alene River Survey

In 1999 we initiated an inventory of fish populations and harvest in the lower Coeur d'Alene River. A Peterson mark-and-recapture population estimate was conducted in a 5.1 km section of the Coeur d'Alene River during June 1999 (Ricker 1975). Electrofishing was used to capture trout and mountain whitefish in the Coeur d'Alene River as described by Fredericks et al. (1997). Electrofishing was conducted from the old railroad bridge above I-90 downstream to the Cataldo boat ramp (Figure 2). Westslope cutthroat trout and cutthroat/rainbow trout hybrids were combined for the population estimate. Density was reported as fish/km.

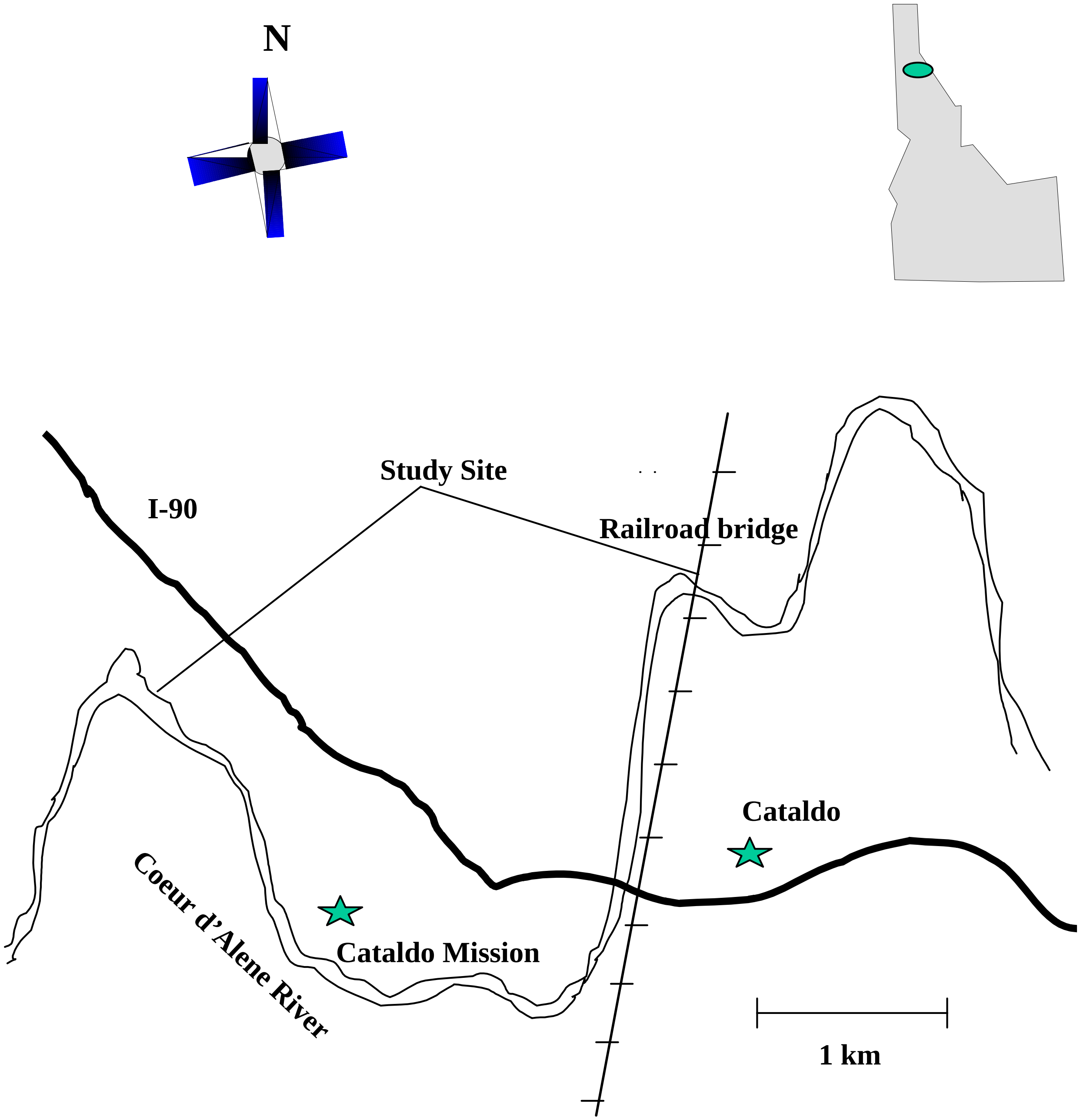

Figure 2. Location of electrofishing transects used to estimate cutthroat trout and mountain whitefish populations in Coeur d'Alene River, Idaho, 1999.

Minimum exploitation estimates were calculated from tags returned from westslope cutthroat and rainbow trout harvested in the Coeur d'Alene River in 1999. A total of 46 trout were tagged, comprised of 41 cutthroat trout, four rainbow trout, and one cutthroat-rainbow trout hybrid.

RESULTS

Bull Trout Spawning Surveys

Lake Pend Oreille Drainage

A total of 712 bull trout redds were counted in the Pend Oreille Lake drainage in 1999 (Table 1). A total of 548 redds were counted in six index streams in 1999 compared to 597 in 1998, both well above the 10-year average (1990-1999) of 458. The 22 bull trout redds counted in Wellington Creek is the highest count recorded in recent history, but similar to counts in the early 1980s (Table 1).

Expanding the number of redds observed by 2.2 and 3.2 fish/redd (Bonar et al. 1997, Fraley and Shepard 1998, respectively), an estimated range of 1,566-2,278 bull trout entered the 18 stream reaches surveyed in the Pend Oreille Lake drainage in 1999. The estimated number of bull trout that entered the six Pend Oreille drainage index stream reaches to spawn in 1999 ranged from 1,205 to 1,712.

Priest Lake Drainage

We counted 58 bull trout redds in the Upper Priest Lake drainage in 1999 (Table 2). The greatest number of redds were counted in the Upper Priest River between Rock Creek and the Upper Priest Falls. The number of redds counted in any of the tributaries to the Upper Priest watershed have rarely exceeded three with the exception of Hughes Fork, Gold Creek and Trapper Creek (Table 2). Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 127-185 bull trout entered the Priest Lake drainage index stream reaches to spawn in 1999.

St. Joe River Drainage

A total of 69 bull trout redds were counted in the three index streams in 1999, a significant increase from the 15 redds counted in the same streams in 1998 (Table 3). Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 151-220 bull trout entered the St. Joe drainage index stream reaches to spawn in 1999.

Table 1. Number of bull trout redds counted per stream in the Pend Oreille Lake drainage, Idaho, 1983-1999.

Stream	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
<u>CLARK FORK R.</u>	--	--	--	--	--	--	--	--	--	2	8	17	18	3	7	8	5
Lightning Cr.	28	9	46	14	4	--	--	--	--	11	2	5	0	6	0	3	16
East Fork*	110	24	132	8	59	79	100	29	--	32	27	28	3	49	22	64	44
Savage Cr.	36	12	29	--	0	--	--	--	--	1	6	6	0	0	0	0	4
Char Cr.	18	9	11	0	2	--	--	--	--	9	37	13	2	14	1	16	17
Porcupine Cr.	37	52	32	1	9	--	--	--	--	4	6	1	2	0	0	0	4
Wellington Cr.	21	18	15	7	2	--	--	--	--	9	4	9	1	5	2	1	22
Rattle Cr.	51	32	21	10	35	--	--	--	--	10	8	0	1	10	2	15	13
Johnson Cr.*	13	33	23	36	10	4	17	33	25	16	23	3	4	5	27	17	31
Twin Cr.	7	25	5	28	0	--	--	--	--	3	4	0	5	16	6	10	19
Morris Cr.	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1
<u>NORTH SHORE</u>																	
Trestle Cr.*	298	272	298	147	230	236	217	274	220	134	304	276	140	243	221	330	260
Pack River	34	37	49	25	14	--	--	--	--	65	21	22	0	6	4	17	0
Grouse Cr.*	2	108	55	13	56	24	50	48	33	17	23	18	0	50	8	44	50
<u>EAST SHORE</u>																	
Granite Cr.	3	81	37	37	30	--	--	--	--	0	7	11	9	47	90	49	41
Sullivan Springs	9	8	14	--	6	--	--	--	--	0	24	31	9	15	42	10	22
North Gold Cr.*	16	37	52	8	36	24	37	35	41	41	32	27	31	39	19	22	16
Gold Cr.*	131	124	11	78	62	111	122	84	104	93	120	164	95	100	76	120	147
Total 6 index	570	598	571	290	453	478	543	503	423	333	529	516	273	486	373	597	548
Total of all streams	814	881	830	412	555	478	543	503	423[a]	447	656	631	320[b]	608	527	726	712

[a] Represents a partial count due to early snow fall.
[b] Observation conditions impaired by high runoff.
* Represents index stream

Table 2. Description of bull trout survey locations, transect locations, distance surveyed, and number of redds observed in the Priest Lake drainage, Idaho, 1992-1999.

Stream	Transect description	Distance (km)	1992	1993	1994	1995	1996	1997	1998	1999
Upper Priest River	Falls to Rock Cr.	4.5	--	--	--	--	15	4	15	33
	Rock Cr. to Lime Cr.	1.1	--	2	1	1	2	0	3	7
	Lime Cr. to Snow Cr.	2.4	--	3	4	2	8	1	10	9
	Snow Cr. to Hughes Cr.	4.4	--	0	0	--	0	3	7	4
	Hughes Cr. to Priest	1.6	--	0	0	--	0	--	--	0
Rock Cr.	Mouth upstream to F.S. trail 308 crossing	0.5	0	0	--	--	2	1	0	--
Lime Cr.	Mouth upstream 0.8 km	0.8	0	0	--	--	0	2	0	1
Cedar Cr.	Mouth upstream 1.6 km	1.6	--	0	2	1	0	1	0	0
Ruby Cr.	Mouth upstream to waterfall above F.S.Rd 655	2.0	0	0	--	--	--	0	0	--
Hughes Cr.	North end of Hughes Meadow to F.S. trail 312 crossing	2.0	7	3	2	0	1	4	0	1
	Foot bridge on F.S. trail 311 downstream to F.S. road 622 bridge	2.4	2	0	7	1	2	0	0	0
	F.S. road 622 downstream to mouth	8.0	--	1	--	--	2	3	1	0
Bench Cr.	Mouth upstream 0.8 km	0.8	0	2	2	0	1	0	0	0
Jackson Cr.	Mouth upstream to F.S. trail 311 crossing	1.6	4	0	0	0	0	0	0	--
Gold Cr.	Mouth upstream 2.0 km	2.0	5	2	6	5	3	0	1	1
Boulder Cr.	Mouth upstream of	1.6	0	0	0	--	0	0	0	--
Trapper Cr.	Mouth upstream 0.8 km upstream from East Fork	3.2	--	4	4	2	5	3	8	2
Caribou Cr.	Mouth upstream to old road crossing	1.6	--	1	0	0	0	0	0	--
	TOTALS		18	18	28	12	41	22	45	58

Table 3. Number of bull trout redds counted in the upper St. Joe River and tributaries in 1992-1999.

	Number of redds[a] observed							
Stream	1992	1993	1994	1995	1996	1997	1998	1999
St. Joe R. from Heller Cr. To St. Joe Lake[b]	10	14	3	20	14	6	0	10
Beaver Cr. and Bad Bear Cr.	2	2	0	0	0	0	1	--
Fly Cr.	--	--	--	0	0	--	2	--
Heller Cr.	0	0	--	0	--	1	0	--
Medicine Cr.[b]	11	33	48	26	23	13	11	48
Mosquito Cr.	--	--	--	0	4	--	2	--
Red Ives Cr.	--	0	--	1	0	1	0	--
Sherlock Cr.	0	3	--	2	1	1	0	--
Simmons Cr.	--	7	5	0	--	0	1	--
Wisdom Cr.[b]	1	1	4	5	1	0	4	11
Totals	24	60	61	59	44	22	21	69

[a]Only definite bull trout redd sightings are reported in this table. Bright/clean gravel areas reported as "possible" bull trout redds are not included.
[b]Bull trout index streams established in 1997.

Little North Fork Clearwater River

A total of 17 bull trout redds were identified in the upper Little North Fork Clearwater River drainage in 1999, the highest number in the five years that these tributaries have been surveyed (Table 4). One redd was observed in Lund Creek while Little Lost Lake Creek and the Little North Fork Clearwater River between Lund Creek and Lost Lake Creek had seven and nine redds respectively. Expanding the number of redds observed by 2.2 and 3.2 fish/redd, an estimated range of 37-54 bull trout entered the upper Little North Fork Clearwater River index stream reaches to spawn in 1999.

Table 4. Summary of bull trout redds counted in the upper Little North Fork Clearwater River drainage, Idaho, 1994–1999.

Stream	1994	1996	1997	1998	1999
Lund Cr.	0	7	2	2	1
Little Lost Lake Cr.	0	1	1	1	7
Lost Lake Cr.	0	0	0	0	
Little N.F. Clearwater					
Lund Cr. To Lost Lake Cr.	--	--	3	1	9
Lost Lake Cr. to headwaters	0	2	0	0	--
Total	0	10	6	4	17

Moyie River Assessment

We collected a total of 874 fish with combined electrofishing and angling efforts (Table 5). Of these, 651 (74%) were mountain whitefish, 122 (14%) were wild rainbow trout and 87 (10%) were brook trout. Three cutthroat, seven cutthroat/rainbow trout hybrids, and four hatchery rainbow trout were also collected, comprising the remaining 2% of the catch. Wild rainbow trout ranged from 134 to 507 mm TL, with a mean length of 248 mm. Brook trout ranged from 142 to 310 mm TL with a mean of 238 mm (Figure 3). Mountain whitefish, the most abundant species collected, ranged in length from 123 to 345 mm with a mean of 226 mm TL (Table 5). A total of 651 mountain whitefish were captured, but total lengths were measured and recorded on only 140 (Appendix A).

Age and growth determinations were made on scales from 30 rainbow trout ranging from 106 to 507 mm TL. Age 3 rainbow dominated the sample (n=12), followed by age 4 (n=7), and age 6 (n=5). Ages 1, 2, and 5 had two fish each. No fish older than age 6 were collected. Average back-calculated lengths at age from scale samples for rainbow trout was 98 mm, 150 mm, 205 mm, 260 mm, 334 mm, and 391 mm for fish age 1-6, respectively (Table 6). During our July 7-8 effort, 122 rainbow trout and 85 brook trout were tagged with reward and non-reward floy tags in the Moyie River. Three tags from each group of fish were returned by anglers in 1999 resulting in exploitation estimates of 2.5% for rainbow trout and 3.5% for brook trout. All six tagged fish were caught and harvested in August within 4 km of the study site.

We applied the index RSD to assess Moyie River rainbow and brook trout and to quantify length-frequency data. Weights of wild Moyie river rainbow and brook trout were compared to standard weights as benchmark for comparison. Wild rainbow trout RSD-13 in the Moyie River was 20.6, indicating 20.6% of rainbow trout sampled were greater than or equal to 13 in (325 mm) TL. RDS-10 for brook trout was 37 in 1999.

Relative weight (W_r) was used to evaluate the condition of Moyie River rainbow and brook trout. Differences in growth forms between juvenile and adult fish and errors inherent in the weighing of small fish in the field were avoided by using established minimum total lengths for both species. Minimum lengths of 200 mm and 130 mm were used for rainbow and brook trout respectively (Murphy et al. 1991). Total lengths and weights ranged from 212 to 360 mm TL and 80 to 480 grams for rainbow trout. Brook trout total lengths and weights ranged from 193 to 271 mm TL and 70 to 220 grams. From these weights and comparisons with the “standard” weights for rainbow and brook trout, we calculated mean W_r of 91% and 92% for Moyie River rainbow and brook trout respectively. For Moyie River rainbow trout, the trend across these lengths appears to be a slight decrease from the standard as length increases (Figure 4). Relative weight for 325 mm rainbow was 92 with a mean of 91 across all lengths. Moyie River brook trout reflected the standard with a value of 99 at 250 mm and 103 at 271 mm (Figure 5).

Efforts to estimate rainbow and brook trout populations were unsuccessful due to an inadequate number of tagged fish being recaptured.

Table 5. Relative species composition, number captured by angling and electrofishing and mean lengths of fish collected in Moyie River, Idaho, July 7-19, 1999.

		Gear Type			
Species	Data	Angling	EF	Total	Species composition by percent
Brook trout	Number captured	22	65	87	10%
	Mean length (mm)	231	241	238	
Cutthroat trout	Number captured	2	1	3	<1%
	Mean length (mm)	224	249	232	
Hatchery rainbow	Number captured	0	4	4	<1%
	Mean length (mm)			238	
Rainbow/Cutthroat	Number captured	7		7	<1%
	Mean length (mm)	266		266	
Rainbow trout	Number captured	41	81	122	14%
	Mean length (mm)	263	251	254	
Mountain whitefish	Number captured		651	651	74%
	Mean length (mm)		226	226	
TOTALS				874	

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Table 6. Back–calculated length at age for rainbow trout in the Moyie River, Idaho, 1999.

Year Class	Back-calculation Age							
	Age	N	1	2	3	4	5	6
1998	1	2	92					
1997	2	2	96	146				
1996	3	12	96	146	200			
1995	4	7	98	149	207	252		
1994	5	2	108	165	225	274	344	
1993	6	5	102	156	209	267	331	391
All Classes			98	150	205	260	334	391
N		30	30	28	26	14	7	5

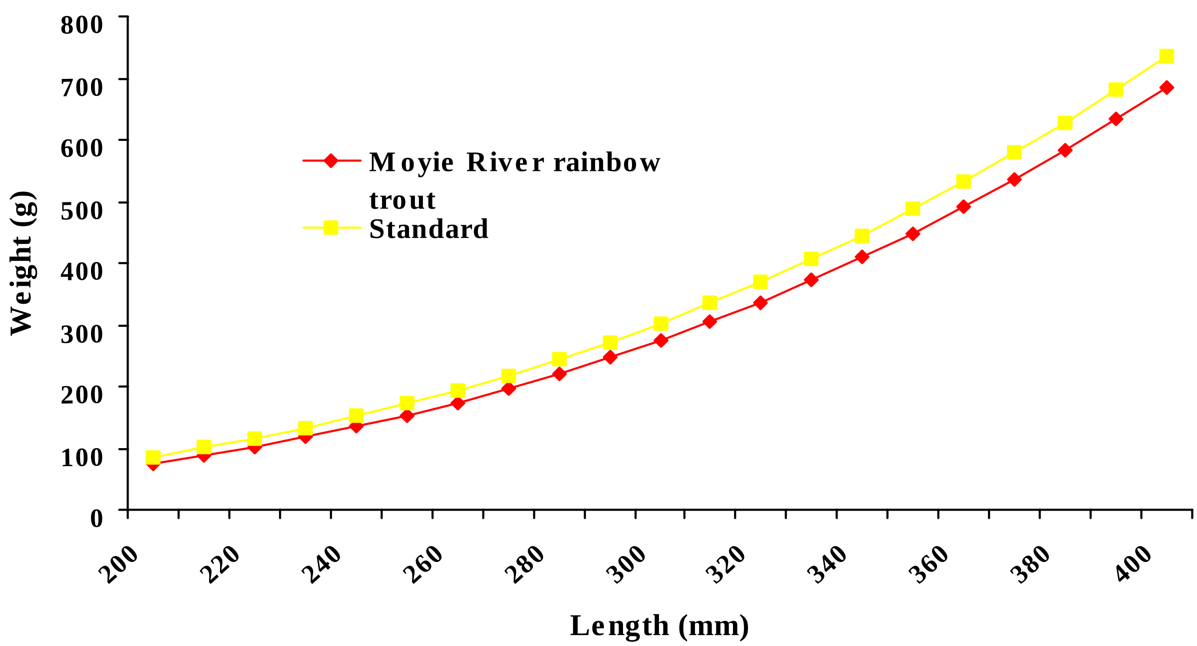

Figure 4. Length-weight relationship of rainbow trout collected from the Moyie River, Idaho, in 1999 compared with the standard length-weight relationship (Wege and Anderson 1978).

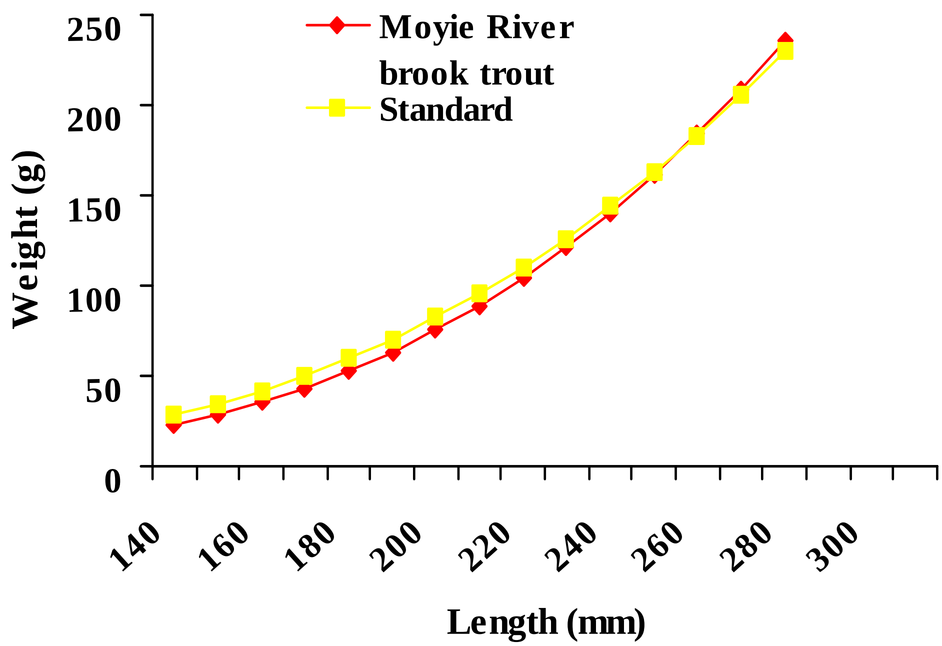

Figure 5. Length-weight relationship of brook trout collected from the Moyie River, Idaho, in 1999 compared with the standard length-weight relationship (Wege and Anderson 1978).

Lower Coeur d'Alene River

Mountain whitefish were the most numerous species captured in our Coeur d'Alene River electrofishing samples in 1999 comprising 46% of the catch (Table 7). Westslope cutthroat trout were the most abundant of all trout sampled, representing 44% of the two-night electrofishing catch (n=286). Hybrids of cutthroat and rainbow trout comprised 7% of the catch (n=44). Wild rainbow trout and brook trout were the next most abundant salmonids sampled each comprising 1.2% of the catch. Four kokanee salmon, *O. nerka kennerlyi,* two juvenile chinook salmon *O. tshawytscha* and two northern pikeminnow *Ptychocheilus oregonensis* were also captured.

Lengths of cutthroat trout ranged from 126 to 485 mm with a mean length of 267 mm. Twenty-six percent of the 286 cutthroat trout sampled were less than 200 mm, while 3.6% of the cutthroat captured were larger than 405 mm. Cutthroat-rainbow hybrid trout were generally smaller with a mean length of 207 mm. Mountain whitefish ranged in length from 54 to 407 mm with a mean length of 220 mm (Table 7 and Appendix B).

Our mark-and-recapture efforts resulted in a population estimate of 2,685 cutthroat and cutthroat/rainbow trout >100 mm in a 5.1 km transect, or 526 trout/km. We estimated 8,412 mountain whitefish in our survey transect, or 1,649 whitefish/km. Mountain whitefish >270 mm were estimated at 159 fish/km.

A total of 41 cutthroat trout and hybrids ranging from 352 to 485 mm were tagged with reward tags in 1999. Anglers returned 11 tags from the Coeur d'Alene drainage; however, only seven of these trout were harvested. Estimated exploitation of cutthroat trout was 17% in 1999. Ten of the 11 returns from cutthroat and cutthroat/rainbow hybrid trout were recovered within 6 km of the sampling area within three months. The one exception was a cutthroat captured in Beauty Bay in Coeur d'Alene Lake, approximately 88.5 km downstream.

Table 7. Summary of species, number captured, mean length, and species composition by percent for an electrofishing survey in the Coeur d'Alene River, Idaho, June 1999.

Species	Number captured	Mean length (mm)	Species composition by percent
Mountain whitefish	300	220	46
Cutthroat trout	286	267	44
Rainbow trout	8	263	1
Cutthroat/rainbow	44	207	7
Brook trout	8	233	1
Kokanee	4	260	<1
Chinook	2	186	<1
Northern pikeminnow	2	293	<1
TOTAL	654		

DISCUSSION

Bull Trout Spawning Escapement

Pend Oreille Lake Drainage

The number of bull trout redds counted in the Pend Oreille Lake drainage in 1999 was comparable to 1998 (Table 1). A total of 712 bull trout redds were counted in the Pend Oreille Lake drainage in 1999, a slight decrease from 726 in 1998, but above the 10 year average of 555. A total of 548 redds were counted in six index streams in 1999. The 10-year average (1990-1999) in these streams was 458. More redds were counted in 10 of the 17 streams reaches in 1999 than in 1998.

The largest one-year decrease in the number of redds counted occurred in Trestle Creek where 260 redds were recorded in 1999 compared to 330 in 1998. However, this is still above the 10-year average of 240. Noticeable increases in the number of redds counted occurred in Lightning, Wellington, Johnson, Twin Creeks and Sullivan Springs.

Some of the increase in the number of redds may be attributed to the prohibition of bull trout harvest in the Clark Fork River and Pend Oreille Lake in 1996. Stelfox (1994) reported an increase from 54 adult spawners in 1991, prior to harvest restrictions, to 650 adult spawners in 1996 in Smith-Dorrien Creek, a tributary to Lower Kananaskis Lake, Alberta. Allan (1997) reported an increase from 35 redds to an average of 53 redds (since 1991) in Line Creek, British Columbia resulting from harvest restrictions on the Fording River/Elk River system. Previous regulations in Pend Oreille Lake protected bull trout under 500 mm, so the total harvest closure extended protection to a relatively small percentage of the population but to a potentially large portion of the spawning population.

Upper Priest Lake Drainage

The bull trout population in Upper Priest River and Upper Priest Lake is very low. The adult bull trout population (>400 mm) in Upper Priest Lake was estimated to be 116 fish (95% confidence limits, 54-230), (Fredericks et al. in press). The 58 bull trout redds counted in 1999 is the highest number recorded since 1992 when surveys began and is well above the eight year average of 30. However, the higher number of bull trout redds counted in 1999 relative to the counts since 1992 may be related primarily to additional areas being surveyed rather than an increase in the spawning population. We began counting transects in the Upper Priest River in 1993 and expanded those counts to include the entire river from the mouth at Upper Priest Lake upstream to American Falls in 1996. Since 1996, the 4.5 km transect from Rock Creek upstream to American Falls has contributed 18% to 57% of all redds counted in the entire drainage. Counts in 1999 more accurately reflect the entire spawning population of bull trout in the Upper Priest River drainage compared to counts in previous years.

St. Joe River Drainage

Available information indicates the bull trout population in the St. Joe River system is the only one remaining in the Spokane River drainage. However, population numbers, based on redd counts, are very low when compared to the Pend Oreille Lake drainage bull trout population and lower than that estimated for the Upper Priest Lake population. Spawning activity is primarily confined to the cold, higher elevation upper reaches of the St. Joe River basin, where very little logging has occurred and road densities are low. In 1999, only the three index streams were surveyed, however, the 69 bull trout redds counted is the highest number recorded since 1992 when surveys began and is well above the eight year average of 45. The increase in redd counts in 1999 showed a similar trend to what was observed in the Upper Priest River and Little North Fork Clearwater drainages. The increase in redds may reflect a strong year class produced by favorable environmental conditions six to eight years ago, or simply variability caused by sampling design (a one time count versus multiple counts to detect the peak of spawning activity) or run timing (Rieman and McIntyre 1996).

Little North Fork Clearwater River Drainage

The population of bull trout in the upper Little North Fork Clearwater River appears to be low. The density of juvenile bull trout upstream from Adair Creek was 0.28 fish/100 m^2 in 1996 (Fredericks et al. 1997) indicating there was likely low spawning escapement in the upper Little North Fork Clearwater River drainage in 1994 and 1995. Bull trout redd surveys in the upper Little North Fork Clearwater drainage were initiated in 1994. The 17 redds counted in 1999 is the highest number to date and above the five year average of 7.5 redds. Redd detection can be very difficult for observers in this area where there is very little periphyton on the substrate. Cleaned gravel associated with redd construction in the fall can not always be used to identify redds. Other factors such as substrate orientation and classic redd construction patterns (i.e. a depression followed by a mound of loose gravel) had to be used to locate redds.

Moyie River

Only four of 888 trout collected in our sample were hatchery rainbow trout, “holdovers” from the 1998 stocking of put-and-take rainbow trout stocking. Based on data collected in 1998 (Fredericks et al., in press) estimates of return-to-creel for domestic Kamloops and Colorado River rainbow trout for the Moyie River were 7% and 3% respectively, far below the statewide recommended return rate of 40%. The cost of rearing 1,903 tagged fish for the Moyie River in 1998 was approximately $0.49/fish, resulting in a cost of $10.41 per fish creeled.

In addition, Canadian fish managers have expressed their concerns about IDFG stocking fish that test positive for infectious pancreatic necrosis (IPN) from the Clark Fork Hatchery into the Kootenai River drainage. These concerns in addition to poor returns of hatchery catchable rainbow trout, have resulted in a discontinuation of all trout stocking in the Moyie River. We will rely on wild trout to provide a fishery starting with the 2000-2001 regulation cycle. For the 2000-2001 fishing season the Idaho Fish and Game Commission adopted a wild trout limit of two fish for the upper Moyie River. The lower Moyie River (below Meadow Creek Bridge) has been managed with a two fish limit since 1992.

Using scale samples and W_r we were able to examine the growth of individual fish and the growth of the population. Considering the production potential of north Idaho streams, rainbow and brook trout condition is surprisingly good in the Moyie River. Our length-weight curve indicates average to slightly better than average growth for Moyie River brook trout when compared to “the standard.” Brook trout exceeded the standard once the fish attained 250 mm. However, these samples were taken in July when brook trout were approaching spawning and may have been heavier than throughout other parts of the year accounting for their “better than average” relative weight. The above average weights of brook trout and high RSD values for both brook and rainbow trout are likely related to the low density trout populations in the Moyie River. Rainbow trout fell slightly below the standard through the entire length of fish sampled with W_r values decreasing with increasing length. This is probably a reflection of environmental limitations rather than a shortcoming in management strategy. Based on back calculation with scales, rainbow trout in the Moyie River experience accelerated growth at age 5, perhaps the result of a shift from an invertebrate diet to a higher energy piscivorous diet (Table 6).

Ideally age structure, size (length) structure, and stock density indices would be calculated from a random sample of the entire population. Unfortunately our sampling effort demonstrates some gear-related length selectivity, and selection of sampling sites using boat mounted electrofishing and angling is biased towards larger trout.

Coeur d’Alene River

We implemented a cutthroat trout slot limit for the 2000-2001 regulation cycle as a management tool to protect native cutthroat trout and simplify regulations. The new slot limit regulation reads as follows: The general trout limit may include only 2 cutthroat trout or cutthroat hybrids and none between 8” and 16”. This change affects the entire Spokane River drainage outside those areas managed as catch-and-release (upper Spokane River, Coeur d’Alene Lake and River, St. Joe River, St. Maries River and their respective tributaries). Harvest opportunity will increase on juvenile cutthroat trout in the mainstem rivers as anglers will be allowed to keep two fish under 8 inches. Harvest opportunity will decrease on juvenile fish in tributary streams. The effect of harvesting sexually immature cutthroat trout from the Coeur d’Alene River and its tributaries will require monitoring to ensure the viability of the fishery. Conservation officers have expressed concerns about large cutthroat trout in the lower Coeur d’Alene River being concentrated, vulnerable and exploited. Our data indicate only a small percentage of the population will exceed the upper end of the slot at 16 inches, and most of these cutthroat will have already spawned more than once. During the spring of 2000, fisheries management personnel will assist enforcement staff in monitoring the new fishery. Hopefully the enhanced enforcement presence during this high use, short-term fishery will help anglers through the transition period from one regulation to another and increase compliance with the new slot limit.

Estimated exploitation of Coeur d’Alene River cutthroat trout from tag returns was 17% in 1999. Apperson et al. (1988) reported cutthroat exploitation was 29% in 1985 and 33% in 1986.

RECOMMENDATIONS

1. Conduct biennial snorkeling surveys in the Little North Fork Coeur d'Alene, North Fork Coeur d'Alene, and St. Joe rivers.

2. Conduct biennial electrofishing population estimates in the Little North Fork Coeur d'Alene, North Fork Coeur d'Alene, and St. Joe rivers to correspond with snorkeling surveys.

3. Survey all eighteen bull trout spawning streams in the Pend Oreille drainage in 2000.

4. Monitor bull trout abundance through redd counts in three index streams (four reaches) in the St. Joe River drainage, Medicine Creek, Wisdom Creek, St. Joe River from Heller Creek to Medicine Creek, and St. Joe River from Medicine Creek upstream to the cascades below St. Joe Lake.

5. Count bull trout redds in the Upper Priest Lake drainage the first week of October.

6. Count bull trout redds in the upper Little North Fork Clearwater River, Lund, Lost Lake, and Little Lost Lake creeks.

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APPENDICES

Appendix A. Length frequency for mountain whitefish captured in the Moyie River, Idaho in July 1999.

Appendix B. Length frequency for mountain whitefish captured in the Coeur d'Alene River, Idaho in June 1999.

1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: II - Technical Guidance

Subproject: I-A Panhandle Region

Contract Period: July 1, 1999 to June 30, 2000

ABSTRACT

Panhandle Region fisheries management personnel provided private individuals, organizations, public schools, and state and federal agencies with technical review and advice on various projects and activities that affect the fishery resources in northern Idaho. Technical guidance also included numerous angler informational meetings, presentations, and letters, continuation of the Panhandle Region portion of the 1-800 ASK-FISH program, and fishing clinics.

Author:

Ned Horner
Regional Fishery Manager

OBJECTIVES

1. To furnish technical assistance, advice and comments to other agencies, organizations, or individuals regarding projects that affect fishery resources in northern Idaho.

2. To promote the understanding of fish biology and fish habitat needs and the ethical use of the fishery resource through individual contact, public school curriculum, club meetings, public presentations, informational brochures and fishing clinics.

METHODS

Regional fisheries management personnel provided both written and oral technical guidance.

RESULTS AND DISCUSSION

The technical guidance provided by Panhandle Region fish management personnel focused on activities that directly affected fishery resources or resource users in north Idaho. Personnel made presentations to numerous civic and sportsmen's groups throughout the year. Letters were sent to numerous individuals and organizations in response to specific questions about the fisheries in northern Idaho.

Fishing Clinics

Regional fishery management personnel coordinated six Free Fishing Day fishing clinics in the Panhandle Region. Department-sponsored clinics were held in Bonners Ferry at the Lions Club Snow Creek Pond, Coeur d'Alene at Ponderosa Golf Course, near St. Maries at Anderson Ranch Pond, at Round Lake State Park near Sandpoint, and at the Clark Fork and Mullan fish hatcheries. We also provided fish and guidance for a clinic at Priest Lake sponsored by the U.S. Forest Service. The clinics were geared toward teaching young anglers how to fish (casting, baiting hooks, etc.), fish identification, the reasons for regulations, fishing ethics and how to clean fish. The emphasis was on education and not competition. Regional personnel, people from other state and federal agencies and sportsmen's groups helped in making the clinics a big success.

1-800-ASK-FISH

Regional fishery management personnel provided information on northern Idaho fishing opportunities for the 1-800-ASK-FISH and Idaho Fish and Game Internet Web Page angler information program. Knowledge of regional fisheries programs and input from tackle shops, local fishing experts and conservation officers were used to provide information on fishing opportunities.

Hatchery Management

Numerous discussions were held with hatchery and Fisheries Bureau personnel and concerned sportsmen to discuss potential cuts in hatchery production and the mothballing of the Clark Fork Hatchery due to the presence of the IPN virus and budget cuts. The Regional Fisheries Manager provided input on how hatchery fish were utilized in the Panhandle Region, where cuts in production could be made with the least amount of impact, and other fish management issues to be considered when the Clark Fork Hatchery was closed.

Catch-out Ponds

The Fisheries Manager provided guidance on keeping stocked rainbow trout alive in the Post Falls Park pond. A unique combination of low river level and hot air temperatures resulted in warm water being pumped into the pond. Trout were stressed and some died. A timer was installed on the pump to activate during the time of day when water temperatures were coolest. Trout stocking will only occur in March, April and early May and will resume again in late September after the water has cooled.

Forest Service and Idaho State Recreational Vehicle Program funding was matched with a total of $30,000 in DJ monies. This funding provided access and parking at an existing pond near Clee Creek along the North Fork Coeur d’Alene River and to construct a new pond near the Bumblebee Campground on the Little North Fork Coeur d’Alene River.

Coeur d’Alene Lake Tribal Cutthroat Hatchery Proposal

The Coeur d’Alene Indian Tribe had proposed to build a hatchery for $2.7 million to produce 100,000 cutthroat fingerlings for supplementing depressed populations in Alder, Benewah, Evans and Lake creeks within the reservation boundaries. The proposal involved collecting and holding a stream-specific broodstock on an elaborate life support system (due to a very limited water supply), then releasing 25,000 fingerlings in each stream. Input was provided to the Northwest Power Planning Council, Bonneville Power Administration and Coeur d’Alene Tribe on alternative ways to meet the production goal and the probable difficulty in holding and rearing wild cutthroat in the proposed hatchery.

Endangered Fish Species Issues

The Regional Fishery Manager provided information on the abundance and status of bull trout and westslope cutthroat trout populations in Panhandle Region waters to numerous individuals, organizations and personnel from state and federal agencies working on issues related to bull trout listing and the petition to list westslope cutthroat trout. The Regional Fisheries Manager coordinated with the Kootenai River sturgeon/burbot/trout research team, Kootenai Tribe, U.S. Fish and Wildlife Service, British Columbia Ministry on Environment and the Idaho Department of Fish and Game Fisheries Bureau to review and comment on issues related to white sturgeon *Acipenser transmontanus* flow requests, conservation culture, ecosystem (nutrient) issues, and transboundary management programs. Additional discussions occurred with the Idaho Department of Fish and Game research staff, U.S. Army Corps of Engineers, Bonneville Power Administration, U.S. Fish and Wildlife Service, Kootenai Tribe of Idaho and British Columbia Ministry of Environment. These discussions addressed the depressed status of Kootenai River burbot *Lota lota* and possible changes in water management in the Kootenai River system to hopefully avoid another ESA listing. The U.S Fish and Wildlife Service received a petition from American Wildlands and the Idaho Conservation League on February 2, 2000 requesting burbot in Idaho be listed as endangered under the Endangered Species Act.

Pend Oreille Lake Water Management

Fishery research personnel were responsible for completing all field activities, while the Regional Fisheries Manager kept the public informed and involved in efforts to change lake level management on Lake Pend Oreille. Several sportsmen meetings were attended, articles were written and interviews were given to newspapers. The Regional Fisheries Manager briefed the Idaho Congressional staff on biological and social issues related to changes in lake level management. The Regional Fisheries Manager participated as an expert witness in a Federal Ninth District Court hearing on November 1, 1999 between the Lake Pend Oreille Idaho Club (LPOIC) and U.S Army Corps of Engineers (COE) to decide at which level the lake would be managed during the winter of 1999-2000. The COE announced its intent to draw the lake down to 2051 in late October after the Northwest Power Planning Council failed to reach a unanimous decision to maintain the lake at elevation 2055. The LPOIC argued that drawing the lake down would harm kokanee and therefore be detrimental to bull trout, a federally protected threatened species. The COE argued that managing the lake to elevation 2051 was within their Congressional authorization and that it would be a bad precedent to allow a fishing club to micro-manage COE operations. Judge Lodge felt LPOIC had cause to sue COE, but they did not give the Corps the required 60-day notice of intent to sue as required by the Endangered Species Act. He recommended a compromise be sought and LPOIC and COE agreed on an elevation of 2053, halfway between high and low lake management levels. The impact of that lake level on kokanee will not be known until the fall of 2000 after trawling is completed.

Box Canyon Dam Relicensing

The Regional Fishery Manager reviewed and commented on fisheries related issues associated with the relicensing of the Box Canyon Dam operated by the Pend Oreille Utility District (PUD) of Newport, Washington. The PUD was a major opponent of higher winter pool levels in Lake Pend Oreille, saying the shift in the timing of water coming down the Pend Oreille River caused a loss of revenue. The Regional Environmental Staff Biologist attended most relicensing meetings and coordinated comments.

Lake Davis, California Northern Pike

The California Department of Fish and Game invited Regional Fisheries Manager Ned Horner, Dave Rutz (Alaska Department of Fish and Game) and Terry Margenau (Wisconsin

Department of Natural Resources) to participate in discussions about the presence of northern pike in Lake Davis. This was the first illegally established northern pike population in California and there was considerable concern about the potential risk to the Lake Davis trout fishery as well as downstream fisheries in the Sacramento River drainage of northern California. Lake Davis was treated with rotenone in October 1997 in a very costly and socially controversial project to remove northern pike, but pike were again found during the spring of 1999. Public pressure would not allow chemical treatment again, so CDFG wanted input on the risk northern pike posed to fisheries in the watershed and to help develop potential options for their removal. The consensus was that northern pike posed a high risk to lake and estuary fisheries and the most realistic method for complete eradication was to drain the lake through a metal screen structure on the outlet.

Miscellaneous

Coordination meetings were held with hatchery, research, enforcement and Fisheries Bureau personnel to insure management goals were achieved. Private pond permits, transport permits, requests for grass carp importation and fish tournament applications were reviewed and forwarded. Requests for commercial guiding activities were reviewed and commented on. Anglers were kept informed of regional fishing opportunities and management programs at club meetings, monthly sportsmen breakfasts, through informational articles written for Panhandle Region newspapers, and numerous interviews with television, newspaper and radio reporters. The regional fisheries management staff presented several programs to Panhandle Region schools on cutthroat trout and participated in other Water Awareness Week activities.

1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: III - Habitat Management

Subproject: I-A - Panhandle Region

Contract Period: July 1, 1999 to June 30, 2000

ABSTRACT

There were no habitat management related activities in the Panhandle Region during this contract period.

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1999 ANNUAL PERFORMANCE REPORT

State of: Idaho

Program: Fisheries Management F-71-R-24

Project: IV – Lake Restoration

Subproject: I-A -Panhandle Region

Contract Period: July 1, 1999 to June 30, 2000

ABSTRACT

There were no lake restoration related activities in the Panhandle Region during this contract period.

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